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ADDRESS AT THE ANNUAL GENERAL MEETING
of the Society held on 25 June 1934, by the President

MAJOR-GENERAL SIR PERCY COX, G.C.M.G., G.C.I.E., K.C.S.I.

I WONDER if any predecessors of mine in the presidency of the Society have contemplated their first Anniversary Address with the same mixture of feeling as that which possesses me to-day. A feeling of pride on the one hand—proper pride, I hope—at being at the helm of such a renowned institution as the Royal Geographical Society of Great Britain; of humility, on the other hand, at realizing after six months' close association with the inner working of the Society's activities and interests, what an extraordinarily wide and varied field they cover, and what scant claim the experience of one short Session can give one to speak of them with authority. And this is especially so in the case of one like myself, who spent some forty years of his life in one geographical region, becoming more and more inclined, I suppose, in the nature of things, to get absorbed in the morsel of the universe just about him, as if it were indeed the hub. True, I always looked forward to my *Journal*, but I have found, as regards my own memory, that however much one may be interested at the time in what one reads in the sphere of travel, reading alone does not suffice, and in the absence of any personal or practical contact with the subject the facts and details soon fade out of memory. I have consequently needed and appreciated the more the generous measure with which my predecessor in the Presidency and other colleagues on the Council have given me the benefit of their experience and support.

Before passing in brief review some of the salient happenings of the past year, let me first discharge the solemn duty which, alas, the Chairman at this Meeting can never hope to be altogether spared: namely, that of reporting to you losses which the Roll of the Society has suffered during the year from the passing of Fellows, and then of referring particularly to those individuals among them who have achieved distinction by way of travel, exploration, or service in the annals of the Society. The total number of Fellows deceased during the year represents about the normal rate. As regards those who have earned distinction in our annals, I will refer to them in the order of their passing.

The President then regretfully referred to the following distinguished Fellows of the Society, giving a brief résumé of the life and work of each: Lady Clayton-East-Clayton, Major W. C. K. Cochran-Patrick, Mr. H. F. Montagnier, Dr. Knud Rasmussen, Captain J. G. Withycombe, the Hon. Miles Staniforth Cater Smith, Dr. F. H. Guillemard, Mr. J. T. Last, Mr. Carsten Borchgrevink, Prof. W. M. Davis, Mr. Douglas Freshfield, and His Majesty the King of the Belgians. Obituary notices of all these have appeared in the pages of the Journal.

When we cast our eye in retrospect over the field of the past year's activities in the sphere of geography there can be little doubt, I think, that the figure which will be found to loom largest, in the view of most of us, will be that colossus of the Himalayas, the mighty peak of Everest, still unconquered, still defiant. In the course of his Anniversary Address last year my predecessor referred to the magnificent efforts which were actually being made at the time by Hugh Ruttledge and his gallant comrades of the fourth Mount Everest Expedition (to use his words), "to place the human foot on the summit of the earth." Alas, a few days later we were to learn, with the keenest disappointment, that the forces of Nature had once more intervened, this time at the eleventh hour, to defeat the designs of man.

No expedition, I am convinced, could have been run with better judgment, or with greater efficiency and determination than this one, and it was a great credit to the leader that he brought his party through without casualty; but it has now been abundantly demonstrated that even a perfection of human effort cannot be expected to achieve success unless reasonable favour on the part of the elements is vouchsafed to the climbers, at the final critical stage. Some luck in the behaviour of the weather is essential. It is of course the last 1000 feet that has become the crux of the problem, and we must face the fact that from whatever point it is attempted, the final climb is going to be exceedingly difficult. Norton, Smythe, Wyn Harris, and Wager were all stopped approximately at the same point, and no better route apparently exists on that line of attack. On the other hand the air photos taken by the Mount Everest Flight show that what we have been accustomed to speak of as the "final pyramid" is actually a knife-edged crest, with its steeper face on the southern side; but the now proven difficulties of the northern approach naturally tend rather to turn our thoughts to the southern face, and this the flight photographs show to be composed of magnificent truncated spurs and couloirs, not at first sight at all promising, but nevertheless inviting reconnaissance; while the high glaciated area between Mount Everest and Chamlang, to the south, seems to be of outstanding beauty and geographical interest, quite different from the terrain on the north side of the mountain.

Mention of geographical interest in connection with the Everest project reminds me that at the time of the dispatch of the 1933 Expedition and again on its return I and others among my colleagues on the Council of the Society heard the view expressed from time to time that most of the physical and other obstacles which had had to be encountered in the assault on Everest had either been eliminated or greatly reduced by the work carried out and experience gained on these successive expeditions, and that what remained was a mere matter of expert climbing, to which no geographical interest attached, such as

would justify the Royal Geographical Society in being associated with it any longer. This opinion had indeed been expressed before, with reference to earlier expeditions, but could now be advanced with more force.

Well, ladies and gentlemen, you are probably aware that the affairs connected with the standing project for the climbing of the mountain, such as the task of securing permission from the local authorities concerned, through the Government of India, for the entry of an expedition into the country; the collection of funds, and choice of a leader when once permission for a party to enter the country is obtained, has been vested in the hands of a small Joint Committee, styled the Mount Everest Committee, composed of three representatives of the Royal Geographical Society, including the President for the time being, and three delegates from the Alpine Club. A few weeks ago, when the Committee's task of winding up the business affairs of the last expedition had been completed, the representatives of the two Societies decided to place themselves in the hands of their respective Councils, recommending to them that the existing Committee, having completed its labours in connection with the 1933 Expedition, should be dissolved, and that the two Societies should consider the advisability of making fresh nominations for a new Committee, which would deal with the future of the problem. The occasion thus afforded seemed to be a good one for the Council to take the whole subject into review, and to decide, before nominating their new delegates, what was to be their attitude and policy in regard to the project, for the future. The position was carefully examined and the results of our deliberations were briefly as follows: we held that, apart from the general axiom that it is of interest to geography to assist man to explore the vacant spaces on the Earth and to plant his foot where none has stepped before—whether it be on the summit of Everest or the heart of the Arabian desert—the interests of geography in one form or another had undoubtedly been served to no inconsiderable extent by the labours of the successive expeditions which had been organized to attempt the conquest of the mountain. It was also held that there was considerable survey work left to be done and that each expedition had made and could make valuable contribution to knowledge in such spheres as meteorology, acclimatization, and diet, which would be of service to all travellers at high altitudes. We also arrived at the opinion that apart from their claim to purely geographic interest, the cumulative effect of these several expeditions and the public interest aroused by them had gradually made the Conquest of Everest a national ambition, which we considered must be pursued relentlessly to a finish by British mountaineers and that the Royal Geographical Society could not now remove its hand from a plough which it had helped to start and keep in motion from the beginning.

Having arrived at these conclusions we decided to re-form the Everest Committee, whose first duty would be to see that no opening was missed for seeking permission for a fresh effort, for in these cases the opportunity often comes suddenly when least expected. I very much hope the attitude of the Royal Geographical Society in this connection will have the sympathy of this audience.

As readers of the *Journal* know, the paper in which Mr. Ruttledge gave his brief account of the expedition in November appeared in the January *Journal*.

His book, which will contain the full account and to which we greatly look forward, will be published in the early autumn.

From the Mount Everest Expedition 1933 it is easy to carry our thoughts on to the Mount Everest Flight; and here it is of interest to note that at the same time that the Government of India succeeded, after a long interval of eight years, in obtaining the consent of the Tibetan authorities to the passage of another Everest expedition through their territory, general sanction was also accorded by the Nepalese Government to an aeroplane flight over Nepal. This was in August 1932.

Earlier in that year, Major Blacker, convinced that the new Pegasus engine now on the market had put a fresh complexion on the problem, submitted to this Society a plan "to reconnoitre and to map by air-photography the almost unknown southern slopes of the massif of Mount Everest"; and after careful inquiry the Council expressed to the Secretary of State for India their opinion that, in the event of permission being accorded to Major Blacker to carry out the flight, results of scientific importance were likely to be obtained. The leaders of the Flight Expedition have always rendered cordial acknowledgment of the value to them which this early manifestation of our support proved to possess, and in their subsequent book, 'First over Everest,' they allude to the fact in the following appreciative terms: "The benediction of the Royal Geographical Society was the foundation-stone of the Expedition's plans." Elsewhere, too, they speak gratefully of the co-operation which they received from us throughout their preparations in connection with the technical side of their photographic-survey plans.

Unfortunately, since Major Blacker had first brought forward his project, the general depression which prevailed in financial circles had increased in intensity, and in consequence a considerable proportion of the contributions which had seemed in sight at the beginning of the year failed to materialize. An appeal was accordingly made to the generosity of Lady Houston, who had repeatedly shown a keen interest in flying-enterprise, and it met with splendid response. The promoters now felt free to push on with their plans, and, as we know, carried them through successfully, but inevitable delays occurred in the discussion and adjustment of details, and by the time it was ready to start the expedition which was originally styled "The 1932 British Flight to Mount Everest" had become "The Houston-Mount Everest Expedition 1933." Plans and personnel under the executive command of Air-Commodore P. F. M. Fellowes reached India in March and the first flight took place on April 3.

It is probably within your knowledge that political objections had hitherto stood in the way of any approach to the mountain from the south, but now, thanks to the enlightened attitude of the Nepalese Government, the embargo in this respect was relaxed and permission was given, first for one flight only, and then, fortunately, for a second one. The photographs taken by the expedition were of three categories: verticals, obliques, and motion pictures, and are of considerable geographical interest and value in themselves; but their full significance cannot immediately be appreciated, and pending an exhaustive study of the negatives no little responsibility rests on those in whose keeping they remain. As regards the verticals, the plotting of them was well

described by Lieut. J. S. Salt, R.E., of the Geographical Section of the War Office at an Afternoon Meeting in this Hall in December last. Work is still in progress on the obliques in the Society's House.

The leaders are heartily to be congratulated on the successful accomplishment, and that without casualty, of what was a great and gallant adventure, well planned and boldly carried out. The only matter for regret is that more time could not have been placed at their disposal, so that they might have taken fuller advantage of such a great opportunity.

After Mount Everest the Libyan Desert seems to have figured most prominently in our record for the year, and it is indeed remarkable how great is the attraction which the desert regions of the world seem to have for the explorer of to-day. Thus the Great Arabian Desert, the Libyan Desert, and the Sahara have all been under recent toll. I think the fascination must lie in the element of legend and mystery which so often attaches to desert places, and in the longing to make the sand-seas deliver up their treasure and their dead.

Thus last year Major Bagnold was pursuing his strenuous activities, crossing and recrossing the said sand-seas, and demonstrating to us the wonderful capabilities of the motor car for desert travel, when handled with the care and skill which he was able to bring to bear. The account of his last journey, with its valuable appendices, came in to this year's record.

Then we find Dr. John Ball, former Director of Desert Surveys under the Egyptian Government, suggesting the great possibilities offered by the Qattara depression in the northern desert for establishing power-production with water from the Mediterranean. More recently, and in a different vein, we have listened to a very interesting joint account by Wing-Commander Penderel and Dr. Bermann of their exploration of the great plateau of the "Gilf Kebir," their discovery of numerous rock paintings, and their search for the mystery oasis of Zerzura and even for traces of the lost army of Cambyses! Lastly, Lieut. Orde Wingate, a strong upholder of the Camel *versus* the Car, has given us an account—and a very vivid and attractive one—of a lone and modest trek undertaken by him in the same neighbourhood, also in search of Zerzura still in hiding. "No one," he tells us in his closing words, "going forth in the spirit of adventure has found more joy and delight in the fulfilment of his enterprise than I did in the failure of mine." Surely that is the spirit of the best type of young explorer.

Apart from the foregoing we have had as usual a varied series of lectures describing the work of expeditions and scientific enterprise in the geographical field in divers quarters of the world: Greenland, Assam, and the Eastern Himalayas from that veteran traveller and medallist of our Society, Captain Kingdon Ward; Central Africa; the Antarctic; Luristan; and so on.

I referred just now in presenting the Murchison Award to Mr. John Rymill, to his having taken over the leadership of the Second Greenland Expedition after Gino Watkins' death. In December last Mr. Rymill gave us a full account of the experiences and work of the expedition and explained how, according to the belief of his comrades, the tragedy must have occurred. I only revert to the subject now for a moment just to mention, in case there are any here who are not aware of it, first that the kayak from which Gino Watkins

lost his life and which was afterwards recovered, now hangs on the wall of the Society's Museum, with all its hunting gear *in situ;* and secondly, that the Memorial Fund for which appeal was made by his friends in his memory has now reached a capital sum which will provide an income of £50 per annum, to be devoted to the support and interests of Polar Exploration. Contributions to the Fund are still welcome.

Reverting for a moment to the subject of our lecture-fare during the past session it is a pleasure to mention, as an indication of the fact, though none should be needed, that the Society is interested in other aspects of geography besides exploration, a paper read to us in January by my predecessor's daughter, Miss Cecilia Goodenough, entitled "Homesteading in North-West Canada," which may be roughly interpreted "Man breaking down the backwoods"! The paper was admirably delivered and made a great appeal to her audience.

I may fittingly conclude my remarks on this part of our activities by recording our appreciation of the visits of distinguished foreign explorers and geographers who have been so good as to come over here to read papers to us. First, Monsieur Joseph Hackin, a member of the Citroën-Haardt Motor Expedition across Asia, who gave us a most graphic and finely illustrated account of the passage of the expedition through Persia and Afghanistan, after the lamented death of the promoter, Monsieur Haardt, during the course of the journey; Dr. Bermann, whom I have already mentioned; Monsieur de Martonne, Professor of Geography at the Sorbonne, and one of the most distinguished geographers of his generation; our old friend Dr. Rickmer Rickmers; and Monsieur Conrad Kilian, who in five years' strenuous sojourn in the south-east Sahara has made a most important contribution to the exploration of the region and who is at the moment busily occupied as President of the Committee of Management of a Saharan Exhibition now open in Paris, to which the Society sent a considerable amount of material in the way of maps, diaries, etc., and at which the Council was ably represented by their colleague, Mr. Francis Rodd.

Our prospects for next Session seem very promising. We have several expeditions either just started or starting, just returned or soon expected, and we hope to enjoy the results of them all in this hall. I can only briefly mention them here. Dr. Longstaff, our late Honorary Secretary, and Dr. Wordie, who succeeds him, have started together for the Arctic Coast of Canada where, if favoured by the weather, they should be able to accomplish important work; Dr. Humphreys and Edward Shackleton, a chip of the old block, leave in a few days for the Arctic, as you have already heard; John Rymill, thanks to the reputation that he has already earned and the strong support that his plans have consequently received both from the Government, from this Society, and from generous individuals and institutions in the country, has been able to plan an expedition to the Antarctic on a scale from which we hope for most important results. Then, among those just returned, we have Major Hay from the North-West Frontier of India; Sir Aurel Stein from Persia; Mr. Thesiger from the Dankali Country; Major Cheesman from the Lake Tana region of Abyssinia. They must all have material which will be of interest to us.

So far I have been discussing mainly the activities in progress in what I may

call our external sphere; let me now touch briefly on our domestic affairs in this dear home of ours. Speaking of the building I may tell you that I constantly hear, as I hope you do, ladies and gentlemen, its praises sung by both friends and foreign visitors, and I feel that we cannot be too grateful to those who planted us here. As to our financial position, as you know we always want money, for we have always excellent objects on which to spend our income, and we do not attempt to save; but our finances are in a solvent and satisfactory condition, and this enables us occasionally to give handsome support to expeditions that appear to us deserving of it. So we are reasonably fortunate, considering the hard times we live in; but we do need more Fellows.

We have been rather unfortunate, on the other hand, in the loss of eminent members of the Society's staff. Last year, as you remember, Mr. Reeves, our Map Curator, left us on retirement after many years' distinguished service to the Society; and now, as you have just heard, we are to lose our priceless Librarian, Mr. Edward Heawood, who in that capacity has earned a wide reputation, not only with his own countrymen but also among the Geographical Societies of Europe, not only for his erudite knowledge of his subject but also for the generous sympathy and camaraderie with which he is always ready to place it at the disposal of his contemporary experts. We are glad to think that we shall still have the advantage of his advice and interest both as Emeritus Librarian and as a Member of our Council.

His second-in-command, Mr. G. R. Crone, has served a long apprenticeship under his direction and is highly deserving of his promotion.

These changes have given the Council an opportunity to sanction various adjustments in the pay and position of members of the Staff, and as a newcomer I have been impressed by the smoothness with which the machine works under the experienced management of our distinguished Secretary, whose endeavours to make my work easy I have greatly appreciated.

With those words let me close my address.

THE OXFORD UNIVERSITY EXPEDITION TO SPITSBERGEN, 1933: *A paper read at the Evening Meeting of the Society on 19 February 1934, by*

A. R. GLEN

THE Oxford University Exploration Club, after having departed from the Arctic habit for several years, decided to renew its Arctic work in 1933 by sending an expedition to Spitsbergen. Mr. J. H. Martin was appointed leader of the expedition, and Mr. A. R. Glen carried out the work of organization in the absence of Mr. Martin on a sledge journey in Canada.

The expedition was only able to take place through the help of the University authorities and the financial assistance generously given by the Royal Society, the Royal Geographical Society, and several Oxford and Cambridge colleges. The Royal Geographical Society also lent a large number of scientific instruments, including a seismograph, a Wild phototheodolite, as well as two ordinary theodolites. Through the good offices of Brigadier H. StJ. L. Winterbotham, the services of three officers of the Royal Engineers were secured, and two other members of the expedition were given instruction in plane-tabling at the Ordnance Survey School at Southampton. The sincere thanks of the expedition are especially offered to Professor Debenham, Mr. Charles Elton, Mr. A. R. Hinks, Professor Kenneth Mason, Sir Douglas Mawson, Dr. T. G. Longstaff, and Mr. J. M. Wordie, amongst a host of other friends.

The Norwegian Government authorities helped us to a very great extent both through Dr. Hoel's office at Oslo, and through their kindness in granting us special Customs facilities. Their wireless station at Advent Bay also assisted us greatly by communicating daily with our base party. Mr. Carl Saether, the British Vice-Consul at Tromsö, acted as agent of the Expedition, and through him the M.S. *Isbjorn*, belonging to Consul Hjalmar Holmboe, was chartered. She proved in every way an admirable ship, and there was nothing which her owner and skipper, Captain Bergesen, would not do to help us. Finally, we were assisted by the generosity of many firms who contributed goods free or at reduced rates. Amongst the former we are especially indebted to Messrs. Cadbury, Chivers, Fairbank Kirby, Imperial Chemical Industries, Nestlé's, Quaker Oats, and Wakefields. To the officials of the B. & N. Line we also offer our thanks for their generosity and many kindnesses to us.

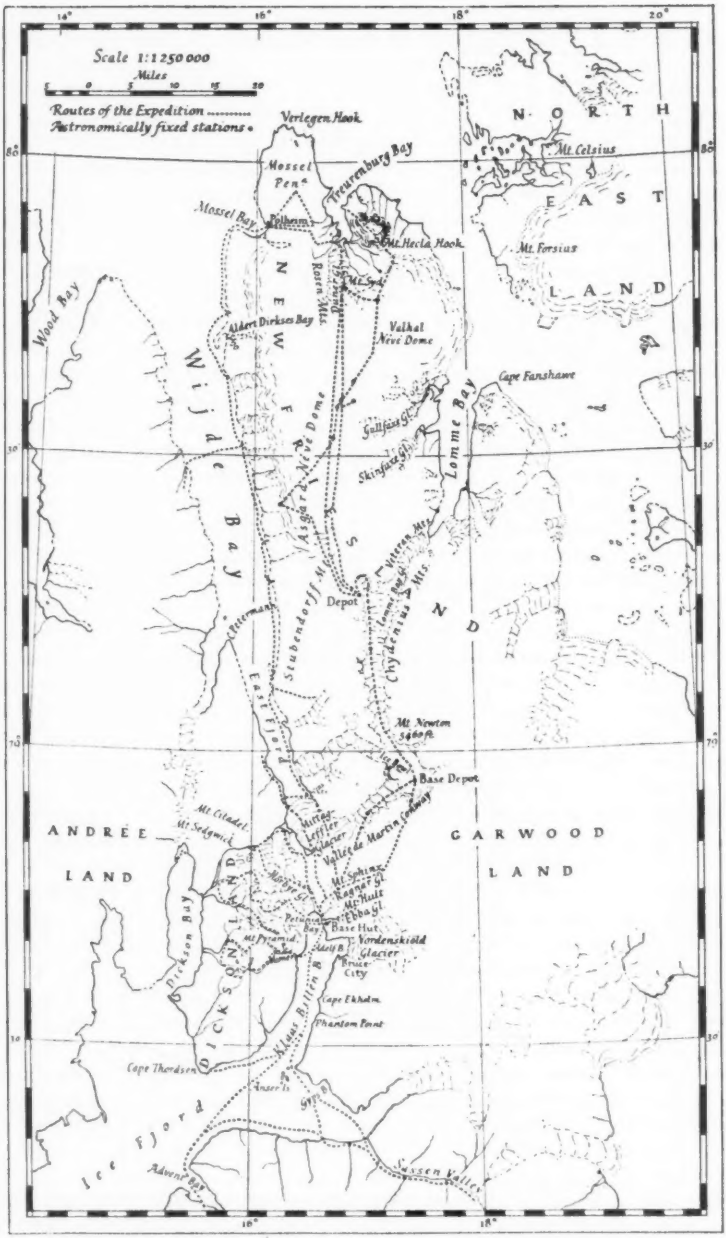
The main work of the expedition lay on the New Friesland ice-cap in the north-east of the main island of West Spitsbergen. This area was almost entirely unexplored, the interior having only been visited in the course of the rapid journey of Captain Staxrud in 1913 on his way to rescue the survivors of the ill-fated Schroeder-Stranz expedition. An account of this journey with aneroid readings is given in Dr. Wegener's book on "Der Rettung von Expedition Schroeder-Stranz." The coastal area must be well known to many trappers, and it seems that they are a potential source of information which is too often neglected. In addition Baron Nordenskiöld's expeditions, which had their base in the summer of 1861 at Treurenburg Bay and over the winter

of 1872–73 at Mossel Bay, have left a certain amount of information; and in the course of the measurement of the arc of meridian in 1898–1902 much excellent mapping of the Treurenburg Bay and Lomme Bay areas was carried out by Baron de Geer. The quality of this work cannot be too highly praised, and much of the survey work of our expedition was based on their trigonometrical points. During the post-war years the Merton College Expedition visited Aldert Dirkses Bay in the Wijde Bay in 1923, and in the previous year Lieut. Mittelholzer made one flight over this area in the course of which he took several photographs.

It was planned that three parties should work in this district, and these were to consist of two sledge parties and one coastal survey party travelling by 18-foot whale boat. One of the sledge parties was to carry out a survey of the east and interior of northern New Friesland while the coastal survey party planned to survey the western coastal district, thereby completing the whole. At the same time geological investigations were to be carried out by both parties, the great questions being the age of the Hecla Hook rock and its relationship to the more highly metamorphosed rocks in this locality. The second sledge party was equipped with the seismograph which is the joint property of the Royal Society and the Royal Geographical Society, and which was used in Iceland during 1932 by the Cambridge Iceland Expedition. It was hoped that by it the depth of the New Friesland ice-cap would be determined. These three parties were to be landed in the Treurenburg Bay, and after completing their work were to return south to the Ice Fjord, at the head of which at Petunia Bay a base camp of eight men was maintained.

In addition to the above plans the base camp contemplated a fairly intensive programme. The interior of the country named Dickson Land lying to the west and north of Klaas Billen Bay was unvisited, and it was intended that a topographical and geological survey of as great a part of it as possible should be made. Visits were planned to the Sassen Valley and to Cape Thordsen in south Dickson Land in order that collections of fossils from the rich beds to be found there should be made. Marine biological, as well as ornithological, observations were also to be carried out, and it was hoped that it might be possible to correlate the results of the two. For this programme two 18-foot whalers, one of which was equipped with a Marston "Sunbeam" outboard engine, were used by this party. Here also was the main wireless station of the expedition, and we hoped that two-way communications could be made with the northern parties as well as with European stations.

Shortly before June 27, the date of departure from England, we suffered a severe loss when it was found that owing to the effects of severe frostbite sustained on his sledge journey in Canada earlier in the year, Mr. J. H. Martin was unable to come. He remained at the head of the expedition's affairs, and with Mr. Charles Elton looked after the interests and business of the expedition in England. Mr. A. R. Glen became leader in the field, and Mr. E. E. Mann, of Southampton, took on the position of second in command, while the Rev. W. L. S. Fleming was in charge of the northern parties. The final division of the personnel was as follows: *Sledge Party A:* Rev. W. L. S. Fleming (geologist), H. C. Smith, R.E. (surveyor), J. M. Edmonds (geologist), A. S. Irvine (camp assistant). *Sledge Party B:* R. A. G. Binny, R.E. (leader),



Routes of the Oxford University Expedition to Spitsbergen, 1933

O. Gatty (seismologist), J. S. Benson (geologist). *Coastal Survey Party:* H. R. de B. Greenwood (surveyor), A. K. Gregson (surveyor), A. C. Geddes (geologist). *Base Party:* A. R. Glen (leader), E. E. Mann (surveyor), J. Brough (geologist), R. H. S. Robertson (geologist), F. E. Stott (marine biologist), C. H. Hartley (ornithologist), J. M. McC. Fisher (ornithologist), J. de Laszlo (wireless operator).

After a somewhat rough journey from Norway, the *Isbjorn* sailed up the Ice Fjord on July 6. For two days she remained anchored in Petunia Bay opposite the Scottish Spitsbergen Syndicate hut which the company very kindly had put at our disposal, and which was to be used as the base hut. During this time the equipment of the northern parties was checked over, skis and sledge runners were waxed, and rations were weighed and packed in the sledge cases. Eventually, on July 8, in glorious weather, everything was finished, and the *Isbjorn* departed for her voyage round the north to the Treurenburg Bay. A call however was first made at the Russian coal mine at Green Harbour, where we purchased several necessary articles, including a small dinghy, and were all very much impressed by the kindness of the Russian authorities. On July 11 we reached Treurenburg Bay, and after all stores and equipment had been landed, the *Isbjorn* left to continue her summer hunting trip round the south and east of North East Land. The pack-ice during the entire summer was very far north, and this enabled her to reach 80° 22′ off the east coast of North East Land.

Between the shore and the Duner Glacier up which a route to the inland ice was to be found lay about 3 miles of coastal plain much cut up by glacier streams. All the sledging equipment had first to be carried over this and on to the glacier itself. Before the two sledge parties started their own work, a reconnaissance party crossed the inland ice with 1000 lb. of food and equipment in order to lay a depot on the south of the cap near the Veteran Mountains. This party consisted of Fleming, Smith, and Binny, and they completed the return journey of 80 miles in sixteen days' hard travelling. When it is considered that they had to climb some 3000 feet with a 1000-lb. load, and that over a great part of the outward journey it was necessary to relay, the speed with which they travelled will be appreciated. Very fine weather was experienced on this journey, and as it was essential for Smith to go on it so as to get an idea of the interior, it made the later bad weather seem all the more unfortunate.

In the meantime Greenwood and Gregson had crossed over from Treurenburg Bay to the Mossel Bay to rejoin Geddes, who had been left there with the boats and equipment of the coastal survey party. Although great difficulty was experienced in finding and recognizing the old trigonometrical points fixed by de Geer, they had eventually succeeded in starting their survey and had carried it over the Mossel Peninsula. Edmunds and Gatty had been investigating the nature of the great stone polygons which they found on the Rosen Mountains to the west of the Duner Glacier, in addition to general geological mapping and investigation of the same mountains as well as of the neighbourhood of Mount Hecla and Mount Syd on the east. They found a new colony of ivory gulls and collected specimens of the young and of eggs, as well as taking many photographs. Finally they made a fairly compre-

hensive entomological and botanical collection of the Treurenburg Bay district.

On July 28 each of the two sledge parties left their double camp underneath Mount Syd, which was known as Syd City, and separated to carry out their own work. Before leaving England it had been decided through the advice of the majority that dogs should not be taken, partly on the grounds of the relative shortness of the journeys to be covered—the longest direct journey, that from Treurenburg Bay to Petunia Bay, being less than 100 miles—and partly because it was considered that the country was unsuitable. This was a mistake. The rapidity of dog transport would have enabled party A with the Wild phototheodolite to take full advantage of the few periods of fog-free weather, whereas much of this was spent in travel. The country proved ideal for dogs as very few crevasses were encountered. This is a case when full use ought to be made of local knowledge and experience, since all the trappers encountered agreed that dogs would have been a very great help. It is worth pointing out that dog teams are obtainable at Advent Bay.

Sledge party A under the leadership of Fleming had as its programme the work of surveying the east and interior of northern New Friesland. For this work it was equipped with the Wild phototheodolite and twenty-four dozen panchromatic and infra-red plates were carried, in addition to the ordinary survey and meteorological instruments. Two Nansen 11-foot sledges and Shackleton-pattern man-hauling equipment were used. On the advice of Sir Douglas Mawson the runners of these sledges were not sheathed either with steel or with German silver, and they proved extremely satisfactory. Pyramid tents manufactured by Messrs. Camp and Sports were taken and also proved very satisfactory, although one or two small alterations would be beneficial. These, together with other suggestions, are fully discussed in Appendix VI. The rationing which was decided upon by the kind assistance of Dr. Zilva of the Lister Institute, proved on the whole satisfactory, although biscuits ought to have been included. It was as follows: Per day per man, 8 oz. pemmican, 4 oz. margarine, 5 oz. Plasmon Powder and Quaker Oats, 4 oz. chocolate, 4 oz. sugar; with the addition of small quantities of concentrated lemon juice, dried yeast, and cod-liver oil.

August 25 had been fixed as the latest date on which either of the two sledge parties were to arrive at the depot previously laid near the Veteran Mountains. Therefore under a month was left for carrying out the work of the party, and this period was further curtailed by the prevalence of thick fogs, due probably to the meeting of warm Atlantic water and the pack-ice in the north-west. The impossibility of quick travel without dogs, combined with the heavy weights which had to be carried, were very great handicaps, and out of the estimated number of twenty-four phototheodolite stations required to complete the survey, it was found possible to occupy fully only nine. A map accurate to about 400 yards was made, based on compass and clinometer shots and tied up by astronomical sights which were taken on every possible occasion. The north of New Friesland was found to consist of an elongated dome of highland ice rising to about 3300 feet at its highest point near its southern extremity, where the Stubendorff Mountains finally emerge from the ice-sheet. Although the ice makes a continuous covering over the interior of

northern New Friesland, it reflects to some extent the sub-glacial characters of the country. The main valley glaciers cut back some miles into the ice-cap, and in particular the Duner Glacier divides the whole ice-cap into the Valhal névé dome on the east and the Asgard névé dome on the west. In addition certain east-west through valleys are marked by slight depressions in the ice. The inland ice is bounded on the west by flat-topped mountains through which four glaciers find their way. Three of these reach the Wijde Bay and possess fine sea faces, but the fourth ends some way from the bay itself. A more detailed description of the west coast of New Friesland will be given in the account of the work of the coastal survey party. In the north the Mossel Peninsula stretches to just past 80° N. at Verlegen Hook, and consists of a flat coastal belt rising to over 1300 feet inland, the higher parts of which are covered in the summer with névé which gives way to slush on the lower ground. A valley runs due west from the Treurenburg Bay separating the Mossel Peninsula from the highland ice of New Friesland, and comes out at the lake which lies some little way inland at Mossel Bay. The Duner Glacier which flows north from the ice-cap to the Treurenburg Bay is bordered on the west by the Rosen Mountains and on the east by the Hecla and Syd Mountains. It ends some way inland from the bay itself, but notwithstanding this, it offers probably the easiest and most gradual approach to the inland ice. An ice-free coastal plain runs round the north-east of the Treurenburg Bay and continues some 10 miles down the east coast of New Friesland when it meets the beginning of the ice cliffs of the 17-mile-long Valhal Glacier which flows down from the Valhal névé dome on the east of the New Friesland highland ice. At the southern end of this glacier the highland ice is flanked by another flat-topped mountain system bordering the Lomme Bay, which joins up with the Veteran Mountains slightly farther west. The main drainage system here is by the Gullfaxe and Skinfaxe Glaciers, but several small glaciers also plunge down from the ice-cap to the Lomme Bay Glacier.

A geological study was made of the rocks outcropping on the north, east, and west of the highland ice, as well as at various points on the return route. All the outcrops which were studied belonged either to the so-called Hecla Hook series of quartzites, limestones, and slates, or to a more highly metamorphosed series of gneisses and schists which have been intruded by acidic magmas. The latter outcrop on the west side of the ice-cap, but owing to their complexity detailed mapping was out of the question. The Hecla Hook series was traced from the Treurenburg Bay along the east side of the ice-cap and in the Veteran and Chydenius Mountains in the centre and south of New Friesland. The relationship between these two main series has long been in doubt, but at several localities the junction between them was found and it is hoped that petrological study will reveal not only the character of each series but also their relationship. The large-scale structure of each was studied in the field. In addition to this a detailed study of polygonal surface markings was made, and after return to the base at Petunia Bay, this was continued at Bruce City some 5 miles distant. Finally the large-scale geomorphology of the north of New Friesland as well as of most of the return route was mapped.

On August 25 the party picked up the food depot previously laid near the Veteran Mountains and made their return journey down a small tributary

glacier flowing from the highland ice on to the Lomme Bay Glacier. This great glacier flows almost due north from a great ice reservoir between the Stubendorff and Chydenius Ranges at the foot of Mount Newton, 5460 feet, which can almost certainly be said to be the highest mountain in Spitsbergen. This ice reservoir is about 5 miles from north to south and lies at an equal elevation of about 3000 feet when it drops in the north to flow down to the Lomme Bay, and in the south into an ice bowl out of which two tributary glaciers flow, one south-west to the Mittag Leffler Glacier 8 miles distant, and the other west-north-west to the Stubendorff Glacier $4\frac{1}{2}$ miles distant. The ice bowl is situated near the southern limit of the Stubendorff Range where on the east the Chydenius Range becomes gradually lower to be swallowed under the highland ice of Garwood Land, which consists of rolling ice slopes reaching about 3700 feet at their highest point. The southern extension of the Chydenius forms the backbone to Spitsbergen, for here is the ice divide. Party A sledged right up the Lomme Bay Glacier on to the ice reservoir at its head and thence into the ice bowl. On a small névé ridge a food depot had previously been laid by a sledge party from the base, and this was picked up on September 4. From here the journey was continued along the glacier described above, which flows down through 1000-feet-high gorges topped by thick snow cornices, to meet the Mittag Leffler Glacier at about 4 miles south of the East Fjord of the Wijde Bay. Twelve miles separate this point from the base, and after sledging up the Mittag Leffler Glacier and down Ragnar Glacier, this party reached the base hut in the evening of September 10. On the following day it had been arranged that a relief party should set out, in the event of their not having returned.

Thus in about seven weeks' work the greater part of northern New Friesland was mapped as well as a considerable part of the return route. Much geological work was carried out, and we hope that one of the two great questions of Spitsbergen geology has been solved—that is, the relation of the Hecla Hook series to the more highly metamorphosed series in New Friesland. Complete meteorological records were kept and a number of observations on magnetic variation taken.

Party B, whose programme it was to attempt to discover the thickness of the highland ice of New Friesland by seismic methods, were equipped with one 11-foot Nansen sledge and one 6-foot sledge. A slightly smaller pattern pyramid hut was used for three men to sleep in. The same cameras as used on the other two northern parties were taken—a Leitz Leica complete with accessories and infra-red and panchromatic films. Again, as in the case of all parties, skis were taken, and the only difficulty experienced was in the wear of the skins. It would probably be better either that Söhm skins should be used or that plush skins and their bindings should be reinforced with stout canvas.

Party B, after having left Syd City, found after a fortnight's trials that the fibre of the Einthoven galvanometer could not stand up to the changes of temperature involved in bringing the instrument out of the cold outer air into the tent. This was a great disappointment, but since the instrument is still in an experimental state, the experience gained and the listing of faults and

likely improvements ought to be of considerable value. The same difficulty experienced in Iceland as well as found by Dr. Wegener in Greenland, that of the presence of alternate layers of snow and névé to some considerable depth, was observed. This would render difficult the carrying out of satisfactory seismograph observations in this locality unless either a deep shaft were sunk or the layers cleared by a large explosion. After it had been found that the failure was due to a radical weakness in the instrument, there was no alternative but to start the return journey to Petunia Bay.

This party followed the same return route as party A and picked up their portion of the two food depots. At the first depot near the Veteran Mountains an interesting although unsuccessful experiment was made when the vicinity of the depot was reached in thick fog. A round of infra-red photographs was taken with the Leitz Leica camera and developed in the tent. The result showed that no great increase of visibility is obtained. On this journey Gatty carried out observations on the formation of corries, and in connection with this took many photographs. One valuable result attained by this party was that by carrying a great part of the dynamite and accessories of the seismograph over the whole journey it showed the seismograph to be a practical proposition on a sledge journey of moderate length. Complete meteorological results were also kept, and amongst the photographs were several of ornithological and geological interest. The base camp was reached on September 1.

When we left the coastal survey party, Greenwood and Gregson had just crossed over from Treurenburg Bay to rejoin Geddes at Mossel Bay, where he had pitched his tent near Nordenskiöld's house at Polheim. This party had one 18-foot whale-boat and one small dinghy in which it had to travel some 80 miles to the head of the Wijde Bay, with about half a ton of gear. They used the same rations as parties A and B, but they were also able to obtain duck and geese, which were fairly plentiful, as well as an occasional seal.

The area of main importance to be surveyed was the western coastal belt of New Friesland from Mossel Bay to the beginning of the Stubendorff Mountains. The average width of the ice-free land was found to be about 5 miles, and the length of the area is approximately 30 miles. In the neighbourhood of Mossel Bay the highland ice approaches much nearer to the sea than elsewhere, and the ascent to it is not unduly difficult. A few miles south of Mossel Bay is a small bay called Aldert Dirkses Bay, and near here is a most interesting piece of country comprising several lakes. The largest of these, known to Oxford Expeditions as Five Mile Lake, starts at the face of a small tributary glacier from the highland ice, and flows to the sea, which it enters through a deep canyon. In a smaller lake to the south an Arctic char was caught by one of the members of the Merton College (Oxford) Expedition of 1923. To the south of this district the ice-cap is bordered by regular flat-topped mountains of about 1200 feet in height. These are intersected by four glaciers, three of which reach the Wijde Bay while the fourth ends some distance from the sea.

It was found that the Mossel Peninsula had been very well mapped by Baron de Geer, so the survey, after having been carried over from the Treurenburg Bay, was continued south. A theodolite triangulation was eventually carried from the Mossel Bay to the head of the East Fjord of the Wijde Bay,

and thence across the Mittag Leffler Glacier to join up with the Norwegian trigonometrical points, Mount Hult and Mount Pyramid, on the coast of Petunia Bay. In addition to this we plane-tabled about 25 miles of the coast from the Mossel Bay southwards, and photographed practically the entire length of coast. Soundings were taken across the Wijde Bay and also some distance down the coast, and full meteorological results kept.

On one occasion the party climbed the highest mountain on the west coast of the Wijde Bay and obtained a fine view of the whole of New Friesland from north to south. When a point opposite Cape Petermann had been reached, the members of this party were so lucky as to find a Norwegian trapper who had just arrived for the winter. They spent several days with him and in the course of the time did some climbing in the Stubendorff Mountains: one glacier near the hut was fully explored, and several peaks near its head climbed. Although they attempted none of the giants, the view in the clear sunshine was unforgettable, and the entire land seemed to consist of range upon range of peaks. Since Mr. R. M. Jackson, of Cambridge, has been working in this area, no survey or scientific work was attempted, but no one will forget the glories of these mountains.

On August 30 the head of the East Fjord of Wijde Bay was reached, and the boats were drawn up on the eastern shore. Greenwood, Gregson, and Geddes crossed over lightly laden on September 1 and arrived at the base camp during the morning of the 2nd. Two days later, reinforced by three members of the Base Party, Greenwood and Gregson returned with a sledge, which was taken down the west side of the Mittag Leffler Glacier by a route on the western side of the nunatak marked N.2 on Mr. R. M. Jackson's map. This western side offers a perfectly flat and uncrevassed route to the edge of the water on the western shore of the East Fjord, and was taken on the advice of the trapper before mentioned. A few days were spent here in completing the survey and in watching birds at the face of the Mittag Leffler Glacier. On September 9 the return journey to the Petunia Bay was made, and the remainder of the equipment brought back, with the exception of the two boats which were left above the winter ice-level.

Portable transmitting and receiving wireless sets were carried by "A" sledge party and by the coastal survey party, and it was hoped that by their agency the parties would be able to keep in communication with the base. The transmitters proved a complete failure however, partly owing to the fact that the operators, through no fault of their own, had had insufficient practice with them before leaving England, partly owing to lack of power, and partly owing to unsuitable topographical features. The receivers proved valuable for the reception of time signals, but until a much lighter set, using either a portable aerial or an aerial contained in the set itself, can be produced, they are not a practical proposition for a long sledge journey.

Meanwhile the work of the Base Party had been continuing very steadily. In marked contrast to the prevalence of fog on the New Friesland ice-cap and to the rather mixed weather encountered by the coastal survey party in the Wijde Bay, the weather in Ice Fjord during July and August was surprisingly fine. One trapper in fact declared that it was the finest summer he had known

since 1908, and on occasions the shade temperature was over 60° F. Mosquitoes proved very troublesome until the latter part of August, when night frosts began to kill them off.

The first few days after the departure of the northern parties were spent in clearing up the base camp and organizing the stores. It was decided that as the proposed journey to Sassen Valley involved the longest open-boat journey, it should be made as early as possible. On July 12 therefore Brough, Robertson, Stott and Glen set off in one of the 18-foot whale-boats fitted with a Seagull outboard engine which had been very generously presented to the expedition by Messrs. Imperial Chemical Industries. After some 10 miles had been covered with a beam sea running, we found that the increasingly heavy sea running up the Ice Fjord from the south would have swamped the boat. This was due partly to the fact that the whale-boat was not decked-in forward and that the engine had been modified to meet the local conditions so that she could only run at full throttle. A landing was made at Phantom Point, but as the weather did not improve there was no alternative but to return to Petunia Bay.

As the motor boat was clearly impracticable for this journey, although excellent for work at the head of the Bay, Mann rigged the other whale-boat with a standing lugsail, and on July 12 with Brough and Robertson started off again for Sassen Valley. A nasty piece of water was encountered at the meeting-place of the Klaas Billen and the Sassen Bays, where there is a powerful current running between the Anser Islands and the mainland. A long submerged reef runs out and makes the channel worthy of close attention. Two days later Brough and Robertson were left at the mouth of the Sassen Valley and Mann continued to Advent Bay single-handed. Contrary winds and the strength of the tides, which approach 4 knots in places, caused him four days' hard rowing before he reached Advent Bay. After spending one night there he returned with a good wind, covering the 50 miles in twelve hours. On July 28 Mann, de Laszlo, and Glen sailed and rowed to Sassen Bay to pick up Brough and Robertson, who spent a fortnight in the Sassen Valley. The latter succeeded in collecting many fine specimens of vertebrate and invertebrate fossils from the very rich Triassic beds in this valley, and although frost weathering had ruined some of the fishes, the smaller invertebrates and ammonites were in remarkably good condition. Three geological sections of the Permo-Carboniferous and Trias were measured by barometer and observations were also made on the general geomorphology of the valley. On July 31 we reached Petunia Bay hut.

On August 4, Mann, Robertson, and Brough started the topographical and geological survey of as great a part of Dickson Land as time and conditions should permit. Since the country was too much cut up to use a sledge, short journeys of not more than ten days' duration were made by back packing. The first of these was made into the northern part, the second into the centre, and the third into the south. About 400 square miles were eventually surveyed both topographically and geologically. The country was found to consist of a high col system in the north, from which several glaciers flow. The first journey was made up the Horbye Glacier, which is about 8 miles in length and which lies to the north of Petunia Bay. At its head there is a col system on the

far side of which two small glaciers run down into an ice-free valley which runs from east to west through Dickson Land. In it was found a perfect example of a watershed, with a lake lying on each side, the larger of which separated the watershed from the Mittag Leffler Glacier. On the far side of this valley stands Mount Citadel, which is the highest mountain in Dickson Land, and which was climbed by Brough and Robertson. Citadel and its adjacent peak, which was tentatively named Mount Sedgwick, both consist of long scree slopes either snow-covered or otherwise with a limestone cap at the top. Glaciation is very much heavier in the north and east, while the west is largely ice free and consists of long dry valleys. The south was found to be made up of small plateaux which were cut up by deep canyons, and consequently travel was rendered somewhat difficult. On the occasion of the third journey to the south, one of the whale-boats was used to reach Cape Thordsen, and after the completion of the survey a temporary camp was made at the old Swedish station in order that fossils might be collected from beds similar to those exposed in Sassen Valley. Bad weather interfered with the work, but some good specimens of invertebrates were obtained. On September 10, Mann, Brough, and Robertson returned to the base hut.

During the middle of August a sledge party consisting of Hartley, de Laszlo, Robertson, and Glen travelled from the base camp to the centre of the ice bowl situated to the south of the ice reservoir at the head of the Lomme Bay Glacier. The route taken was up the Ebba Glacier to the nunatak marked P.2 on Mr. R. M. Jackson's map, which is at the head of this glacier. The journey was continued across the Mittag Leffler Glacier and up the Vallée de Martin Conway. This valley runs approximately north-east towards the central ice divide of Garwood Land, but some 5 miles up it almost merges with the altitude of the highland ice and becomes more part of a large névé dome than anything else. At this point however there is a gentle dip in the general level of the ice running roughly 20° E. of N., and this we followed until it brought us out on a névé dome some 800 feet above the ice bowl itself. Some 3 miles farther on we left the food depot and climbed one of the peaks of the Chydenius Mountains during that evening. We completed the return journey to the base some 24 miles distant the next day.

Early in July it had been found that the centre of life in Klaas Billen Bay was the face of the Nordenskiöld Glacier. Since this was 6 miles from the hut in Petunia Bay, it involved at least a 12-mile return journey whenever the face was to be visited. The petrol supply could not have sustained this consumption, so the biological camp was moved to Bruce City, some $2\frac{1}{2}$ miles from the glacier face. Hartley, Stott, and Fisher remained here throughout the expedition, and since the huts were larger and lighter, they proved more suitable for laboratory work. The outboard motor boat was kept here, and on all possible occasions when work was to be carried out close to the face the other whale-boat stood by. Since this face, which is about 2 miles wide and over 100 feet in height, is constantly calving a certain amount of excitement was always at hand: on one occasion Hartley was struck on the shoulder by a piece of a falling ice pinnacle.

The marine biological work consisted of routine determinations of salinity, temperature, and phosphates at the foot of the Nordenskiöld Glacier, and in

Looking over Dickson Land and Garwood Land peaks, covered by clouds, from Martin Conway névé dome

Mount Newton (5460 feet) from the Lomme Bay Glacier

Above photograph by A. S. L.; all others by A. R. G.

Typical Stubendorff peak visited for the first time by the coastal survey party

East wall of Dickson Land from Mittag Leffler Glacier, showing rock on horizon about 50 feet high, standing on three legs

Looking west, through gorge leading out of ice bowl, to Mounts Citadel and Sedgwick in Dickson Land

Looking up the Horbye Glacier from the Base Hut

the mouth of Adolf Bay. Collections of marine fauna by dredge in the 10-metre zone from Cape Napier to Cape Ekholm were made, as well as plankton collections by fine and coarse nets. The fauna of the freshwater and intertidal pools near Bruce City was investigated, and the marine biologist and the ornithologists made a study of the marine feeding of birds. The two ornithologists concentrated their work on the feeding localities and the feeding habits of all birds in the district, but especially on the feeding of kittiwakes at the face of the Nordenskiöld Glacier. The number of birds and the rate of feeding gave very interesting results, especially the correlation of these with changes in the air temperature and the consequent variations in the amount of glacial drainage.

Living off the country was found to be quite easy at Bruce City, and up till early September it was always possible to shoot enough seals to keep the camp in fresh meat. Geese, duck, gulls, and, in September, ptarmigan were also obtainable: in fact at no time was this party without fresh meat. A small journey was also made on foot by Hartley and Fisher to Gyps Bay to look for kittiwakes' nests. Owing to considerable rain and a leaky tent they welcomed the comfortable shelter provided by a trapper's small hut. No kittiwakes however were found nesting here. Frequent visits were exchanged between Bruce City and Petunia Bay, and a system of signals was also arranged. This was very successful as invariably an ordinary message would be interpreted as a call for a rescue party, and a rapid turn-out would result, much to the gratification of the signallers. The feeding of this camp give some very interesting conclusions which are described in an appendix and which show the need for extreme care in the choice of food for different men engaged in various types of work.

After the return of the northern parties a survey of the coast of Klaas Billen Bay down to Cape Ekholm was made as well as of the face of the Nordenskiöld Glacier. Gatty and Fleming continued their investigations of the polygonal surface markings, and an attempt was made on the hitherto unclimbed Mount Sphinx, which ice-covered rock defeated. Although it had been found impossible to carry on two-way communication between the base party and the sledge parties, the wireless at the base proved very useful. Two-way communication was held every night with the Norwegian station at Advent Bay, and telegrams could thereby be exchanged with England. A wide range of stations in Europe and America were received, and news was heard almost every day. Reception in the evening however was generally bad.

The *Isbjorn* was expected to arrive on September 15, and the interval between the return of party A and that date was spent in packing scientific specimens and camp equipment. By this time the fjord was beginning to freeze over at night, and on the 14th bad weather set in. This continued until the 21st, and there was still no sign of the ship. On the following day it was decided that Geddes, Gregson, Hartley, and Glen should set out in one of the whale-boats for Advent Bay to find out news. Greatly to their relief, about 6.30 a.m. the *Isbjorn* anchored off the base hut, having been delayed by bad storms in the Stor Fjord. Her wireless had been blown down and she had consequently been unable to get in touch with us. In two hours we were ready to sail, and after a call at Bruce City to pick up the biologists and

ornithologists and a call at Sassen Valley to pick up geological fossils, we reached Advent Bay in the early morning of the 24th. We delivered letters from various trappers and said farewell to all our friends there. In four and a half days' time we were in Tromsö, having had a remarkably calm voyage in very fine weather. On the evening of October 2 we reached England after fourteen weeks' absence.

APPENDICES

The following appendices form a preliminary statement of the scientific work done by the expedition. When the data have been more fully investigated fuller accounts will be submitted to the appropriate journals. The Survey reports are held over until the map is finished.

APPENDIX I: GEOLOGY, GEOMORPHOLOGY, AND GLACIOLOGY

A. NEW FRIESLAND

W. L. S. FLEMING (in collaboration with J. M. EDMONDS)

New Friesland forms a peninsula over 55 miles long from north to south and with a maximum width of 25 miles. It is limited on the west by Wijde Bay and on the east by Hinlopen Strait and Lomme Bay.

It has long been known that the east of New Friesland consists of a series comprising mainly limestones, marbles, dolomites, shales, and argillaceous schists, and quartzites, folded along axes oriented NNW.–SSE. or N.–S., and containing no certain fossils. The age of this—the Hecla Hook series—has long presented a problem. A series lithologically similar has been discovered in Bear Island containing fossils of Upper Cambrian and Ordovician age,[1] but so far no fossils have been discovered in the Hecla Hook of New Friesland.

That western New Friesland consists of a more highly metamorphosed series of gneisses and schists with associated intrusive (principally granitic) rocks has also been established, but no localities in the north of the peninsula were found indicating the relationship between the Hecla Hook series and these highly metamorphosed types. Nathorst[2] and others interpreted the latter as a Pre-cambrian fundamental complex, and postulated a fault or thrust junction between the highly metamorphosed rocks and the Hecla Hook series.

Hoel and Holtedahl[3] however believed that the highly metamorphosed rocks represent the lower portions of the Hecla Hook formation injected by granite and gneiss and involved in the Caledonian folding. Sandford[4] accepted an analogous view, and Odell,[5] from a study of similar types in Garwood Land and S.E. New Friesland, has adopted this interpretation.

The more detailed geological work of sledge party A was confined to that part of New Friesland lying north of the southern end of Lomme Bay. After working at Mount Hecla Hook, Mount Syd, and the Rosen Mountains, the party sledged south near the eastern margin of the New Friesland ice-sheet to Gullfaxe and Skinfaxe Glaciers: thence to the west side of the ice-sheet before crossing back to the depot which had been laid on the western side of Lomme Bay Glacier. Opportunities however were afforded to make observations and collect hand specimens at several localities during the journey up the Lomme Bay Glacier,

[1] O. Holtedahl, *Norsk. Geol. Tiddskr.*, vol. v (1918–19), p. 121.
[2] A. G. Nathorst, *Bull. Geol. Soc. Inst. Upsala*, vol. x (1910–11), pp. 261–416.
[3] A. Hoel and O. Holtedahl, *Am. J. Sci.*, ser. 4, vol. xxxvii (1914), pp. 415–424.
[4] K. S. Sandford, *Quart. Journ. Geol. Soc.*, vol. lxxii (1926), pp. 615–665.
[5] N. E. Odell, *Quart. Journ. Geol. Soc.*, vol. lxxxiii (1927), pp. 147–162.

across Garwood Land, and so back to the base camp at Petunia Bay. The information obtained on this homeward journey was of value for comparison with the work done in New Friesland.

The rocks of New Friesland east of a line running approximately due south from Treurenburg Bay, of the Chydenius Mountains, and of at least the eastern slopes of the Veteran Mountains, consist of typical Hecla Hook sediments in a low grade of metamorphism. South of Hecla Hook a great variety of calcareous types, including marbles and limestone breccias, was found. The discovery in the same region of rocks which, from a macroscopic examination, appear to be tuffs and agglomerates is of considerable interest, inasmuch as pyroclastic rocks have not been recorded from the Hecla Hook of West Spitsbergen before H. W. Ahlmann [1] refers to their discovery in the north-west of North East Land by the Swedish-Norwegian Expedition of 1931.

In the neighbourhood of Gullfaxe Glacier an interesting sequence of rock types was observed. From west to east the metamorphism and folding become more intense. The more highly metamorphic types have injections of a granitic magma. Here there appears to be a transition from low-grade Hecla Hook rocks to the higher-grade types which occur in western New Friesland and the Stubendorff Mountains. This provides strong evidence in support of the views held by Hoel and Holtedahl, Sandford, and Odell.

On the western side of the ice-sheet an area of granite, in most places foliated, and bearing melanocratic segregations of hornblende-rich material, was one of the dominant rock types; but the rock specimens collected by Geddes and by sledge party A from the eastern side of Wijde Bay represent a diverse group of metamorphic types both high and low grade, and striking for the fact that types in a different grade of metamorphism were found in close proximity.

The main outline of New Friesland appears to have been determined by block faulting in late Tertiary times. The peninsula is thus a horst, whilst the long and relatively narrow fjord-like bodies of water which bound it on the east and on the west are trough faults. It seems that the faulting dislocated a pre-existing peneplane, probably of Cretaceous age, though no evidence of the accordance of summit levels is available from the greater part of the peninsula, of which all but the coastal regions are covered by an unbroken ice-sheet of unknown thickness.

B. DICKSON LAND

J. Brough and R. H. S. Robertson

Dickson Land may be taken to include the peninsula between Klaas Billen Bay and Dickson Bay, and the country directly north of that as far as the southern limits of Wijde Bay. The amount of geological work carried out in this area in the past has been remarkably small, and almost exclusively confined to the coastal districts. The Petunia Bay region was investigated by the geologists of the Scottish Spitsbergen Syndicate, and others; the Mimer Bay area by Stensio; and the Triassic rocks around Cape Thordsen by the Swedes, working from the old Swedish station there. We addressed ourselves particularly to the geology of the inland regions, and favoured by exceptional weather were able to make a reconnaissance survey of almost the whole of this area.

A well-known line of fracture extends from the eastern arm of Wijde Bay to the head of Klaas Billen Bay. This marked the eastern limits of our area, and it is along this line that the oldest rocks are exposed. These consist of gneisses and schists of the Hecla Hook series. The most conspicuous are pink gneisses, which usually occur in bands from 2 or 3 up to 50 feet in thickness. The colour

[1] H. W. Ahlmann, *Geogr. Annaler*, Heft 2–3 (1633), p. 94.

is due to a preponderance of orthoclase felspar, which in certain bands is almost the sole constituent of the rock. These bright bands are interbedded with dark hornblende gneisses and fine choritic schists, and the whole mass is upended and forms a series of striking and characteristic jagged peaks along the western side of the Mittag Leffler Glacier.

The Hecla Hook outcrop is a relatively narrow band running from Wijde Bay to the north side of the Horbye Glacier. It is bounded by lines of fracture, both to the east and the west. On the west the old rocks are thrust against disturbed Old Red Sandstone, and to the east beds of the Culm series are faulted against them.

The Old Red Sandstone is the basal series in the north of Dickson Land, and good sections were abundant; the whole series was found to be dipping fairly consistently in a southerly direction, at an angle usually about 10°–15°. The lowest beds exposed consisted of over 1,000 feet of red rocks, red sandstones, shaly sandstones, and micaceous shales, with an occasional layer of hard greenish conglomerate. This series contained abundant fish remains, usually fragmentary. It passed upward into a series of greenish shales and fine sandstones characterized by the presence of numerous plant fragments. We discovered several good exposures of the junction between the Old Red Sandstone and the overlying Carboniferous, and these always displayed a marked unconformity.

In the east of Dickson Land, particularly round the head of Klaas Billen Bay, both the Lower and Upper Carboniferous are well developed. The Culm series, mainly of bright yellow sandstones, with occasional shales and coal seams, is very thick in this area, but traced westward it thins rapidly and becomes very uneven in thickness. Finally, in the west of Dickson Land, the Culm is altogether absent, and the Upper Carboniferous limestones lie directly on the Old Red Sandstone. These limestones form an even and persistent group, the main outcrop of which extends across Dickson Land from east to west along the line of the Mimer Valley. From this area the limestone extends as a series of isolated outliers which cap the Old Red Sandstone mountains for several miles to the north. The limestone carries a considerable invertebrate fauna, consisting chiefly of Protozoans, Corals, and Brachiopods.

The general dip of the Carboniferous rocks is to the south, and along the line of the Mimer Valley they are overlaid by the so-called Permo-Carboniferous series. The junction can be observed in many places, and is perfectly conformable. This upper formation consists mainly of interbedded light-coloured cherts and black shales, with occasional limestone bands. The limestones yield productids and other Brachiopods. This series has a low dip to the south, and its outcrop covers many square miles of country in the region south of the Mimer Valley. These beds were traced southward until the outcrop of the black Triassic shales was reached in the extreme south of Dickson Land. Apart from fossil collecting, these rocks were not investigated since they have been studied in considerable detail by Swedish geologists.

The Glaciology and Geomorphology of Dickson Land is interesting and instructive. There is abundant evidence of ice retreat, and ice-dammed glacier lakes are common. Wide empty U-shaped valleys are characteristic of the northern area, and contrast strangely with a series of intersecting V-shaped gorges which are present in the south.

C. THE SASSEN VALLEY

J. Brough and R. H. S. Robertson

The specific object of the short trip to the Sassen Valley was to collect fossils from the marine Lower Triassic rocks. These beds were known to contain both

vertebrate and invertebrate fossils of peculiar interest, and although transport up and down the valley was very difficult, a representative collection was obtained. The most important invertebrates collected were a large series of finely preserved ammonites. Of vertebrates, remains, often fragmentary, of fishes, amphibians, and reptiles were collected.

D. GEOMORPHOLOGY: SURFACE MARKINGS

W. L. S. FLEMING (in collaboration with O. GATTY)

The character of the exposed land surface in Spitsbergen is in large measure controlled by frost action. This has been the main factor governing the precipitous valley-glacier walls, and also the nature of the surface on hill-tops, fans, screes, and the terraced coastal regions. The most striking surface phenomena are the peculiar polygonal markings which appear to be especially characteristic of Arctic and to a lesser extent of Alpine regions. A study of these had been made during the Oxford Expedition to Spitsbergen in 1921 by Huxley and Odell,[1] and by Elton[2] in 1924.

Three members of the sledging parties had opportunities to make a further study of varied types of these polygonal markings at the Rosen Mountains in northern New Friesland and at Bruce City on the east side of Klaas Billen Bay. While detailed study was confined to these areas, polygonal systems of some of these types were observed in the course of the sledging journeys and at Petunia Bay.

The types which were examined comprise convex and concave mud polygons, both with and without rims of vegetation, on a base of tjaele or stone; shingle and stone polygons, the centres of which are formed of more finely comminuted material than their rims, with a tjaele, shingle, or boulder base; and boulder polygons composed of upended stones grouped round large boulders. Trenches were dug in many of these types, so that, in addition to surface measurements, records were obtained of the sub-surface character in polygonal areas.

These investigations revealed several significant facts which are not wholly explained by the theories previously advanced to account for the origin of polygonal markings. For example, in the case of those convex and polygons with vegetal rims, the vegetation extends down to the tjaele and along the base of each polygon, enclosing the mud centre like a cup. The fact that many of the rims of the polygons are formed of upended stones has been frequently observed, but the explanation of this phenomenon as due to lateral pressure consequent on alternating freezing and thawing seems inadequate wholly to account for the upending of large stones in several types of boulder polygons. Further, the initiation of some types of polygons appears to be connected with the existence of a boulder platform.

Alternating freeze and thaw, solifluction, the falling of stones into depressions produced by drying cracks or erosional rills, the obstruction to movement afforded by boulders, the establishment of vegetation with its attendant insolation and filter effects, and the swelling, shrinkage, and flowing of clay, together with the increased comminution by frost action and adhesion in clayey areas—these are all important factors contributing to the production of polygonal markings. The formation of stone stripes, which occur on steeper gradients, appears to be closely related to that of the polygonal markings. Stone streams, stone-banked and turf-banked terraces, and gatherings of frost-borne stones are also common features in the areas investigated, and their occurrence confirms

[1] J. S. Huxley and N. E. Odell, *Geogr. J.*, vol. 63 (1924), pp. 207–229.

[2] C. S. Elton, *Quart. Journ. Geol. Soc.*, vol. lxxxiii (1927), pp. 163–194.

the importance of frost action in governing the nature of the land surface in Spitsbergen.

E. GLACIOLOGY: THE NEW FRIESLAND ICE-SHEET

W. L. S. FLEMING

The central part of New Friesland is covered by a continuous sheet of ice extending some 42 miles from north to south. In the north it is approximately 23 miles broad, and narrows to a width of 7 miles at its southern margin, which is some 4 or 5 miles south of the southern end of Lomme Bay. The approximate area of the sheet is 650 square miles.

This ice-sheet does not form a true ice-cap, since its surface is not completely independent of the underlying topography. The summit of the ice, instead of forming a level surface, comprises a number of broad gently arched domes up to 7 or 8 miles in diameter. The domes are separated from one another by wide shallow sags, or valley-like depressions. Some of these extend right across the ice-sheet and for convenience will be referred to as through-valleys. Their location is probably determined by preglacial valleys in the underlying terrain.

Near the margins of the ice-sheet there are several high independent domes, of which the Valhall Dome is one of the most prominent. This dome is separated from the main ice-sheet farther west by the north-to-south through-valley leading down to Duner Glacier. The dome which was named Bifrost by the Swedish Arc of Meridian Expedition, and which appears on de Geer's map[1] as connected by unbroken ice with the central ice-sheet, is in point of fact separated from the latter by a glaciated valley bounded by rock walls.

The elevation of the snow-line is not easy to estimate. On July 11, at Hecla Hook and Mossel Peninsula, the snow-line extended down to about 1100 feet, whilst, three weeks later, it was 300 feet higher. On both occasions snow was lying some 600–700 feet lower on glacial ice and in sheltered valleys. No marked difference was observed between the altitude of the snow-line on the east and on the west of the ice-sheet, and the main ice-divide is not eccentric. No crevasses, thaw pools, melt-water streams or nunatakkr break the monotony of the central portion of the ice-sheet. Various kinds of sastrugi are the only things which from time to time diversify its surface.

The glaciers which are fed by the ice-sheet are of two main types. In the first place there are normal glaciers such as Duner Glacier which head in through-valleys, whilst the second class comprises glaciers which head in steep-sided ice-corries forming embayments at the margins of the sheet. Some glaciers however such as Gullfaxe and Skinfaxe Glaciers, might be grouped in either class, since each of them heads in an ice-corrie lying at the lower end of a through-valley which is continued westward right across the ice-sheet to Wijde Bay. Crevasses occur near the top of some of the ice-corrie embayments and parallel to their flanks. The glaciers plunge steeply 500–700 feet to the foot of the ice-corries, and then flow at more gentle gradients between precipitous frost-shattered rock walls, which dissect a glacially scoured peneplane. The ice-free surface of the bevelled hilltops is characterized by frost-weathered material which in many places has been sorted to form polygonal markings, stone stripes, etc.

The lower distal portions of the glaciers are free from snow throughout the summer to expose an ice-surface marked by lines of long and narrow hummocks oriented parallel to the direction of ice movement. In some places the hummocks may be attributed to pressure, but as a rule they appear to be due to thaw. Near

[1] G. de Geer, *Mss. Suédoise, Mésure d'un Arc d'Méridien au Spitzberg*. t. ii, s. ix. 1923.

the margins of many of the glaciers however there are lanes of smooth ice overlying lateral morainic material. The gentle gradients of the glacier snouts may indicate that the glaciers are at present retreating. A great part of the dissipation of the glacial ice during the summer takes place by melting, the melt-water being carried away by superglacial and marginal streams, and less commonly in subglacial channels. Part of the glacial debris is deposited by streams as proglacial outwash, while part is transported either englacially or as lateral and medial moraines on the surface of the ice to be deposited at the snout of each glacier as end moraines.

APPENDIX II: REPORT ON THE GEOPHYSICAL SEISMOGRAPH

O. GATTY

The Oxford University Arctic Expedition to Spitsbergen 1933 made a series of tests on the geophysical seismograph lent to them by the Royal Society and the Royal Geographical Society. The tests were carried out from August 2–7 inclusive on the New Friesland Ice Cap with a view to obtain also an estimate of the depth of the ice. No results were obtained, and the conclusions arrived at were: (i) That it is certain that the instrument could be worked as it is from a hut in the Arctic or Antarctic; but (ii) that improved frames for carrying the fibres of the Einthoven string galvanometer, and possibly better fibres as well, are a necessity if the instrument is to be worked on a sledging expedition; (iii) these improvements are highly desirable even for working the instrument from a hut; as is also (iv) the installing of a device to give easy regulation of the tension in the spring that operates the explosion recorder. Trivial improvements would be the construction of some collapsible shading device to render focusing easier as the instrument has to be kept in the dark for this; and an overhaul of the clutch that operates the drum carrying the photographic film. The latter did not work as satisfactorily in the North as it had during successful trials in England. It should be recalled that uncertainties as to the depth to which layers of névé extend will always be a source of error in echo-sounding results on ice unless these results are supplemented by boring.

Five fibres were taken from England and in every case the cold caused the frame that carried them to shrink so that the fibres were touching it for about half their total length. Owing on the one hand to the necessity to work with the instrument in the tent and on the other to the difference in internal and external temperature it was found advisable to sleep with the seismograph in the tent and for it to have the fibre *in situ* in the galvanometer overnight; the desirability of this procedure was not however realized at first. Two of the fibres were broken while adjusting them to clear the frame, these adjustments having to be done several times in cases where the fibre, the galvanometer, and the tent were initially at different temperatures. The remaining three fibres showed discontinuous changes in their sensitivity. Thus they were put into the galvanometer too sensitive, in half an hour they had the correct sensitivity and stayed for at least fifteen minutes like this. Minor adjustments prior to an explosion were made elsewhere during a further fifteen minutes, and by then it was found that the sensitivity had dropped to some 5 per cent. of the desired value. They were then made very slack, but after another half-hour were found to be non-conducting, having been in the galvanometer for the whole of this period.

One non-conducting fibre was brought back intact to England and has been examined by the Cambridge Instrument Company. It was found to be non-conducting close to each of the soldered joints at the ends, and, in addition, at a point opposite the bottom corners of the two metal plates of the side frame.

The rest of the fibre was in good condition. Thus the cold, the temperature changes, and the damp due to condensation in the tent do not disintegrate the fibre as a whole. Probably the break opposite the corner of the frame was due to mechanical damage when the fibre was slack and touched the side. The breaks at the soldered ends may be due to condensation or temperature changes, but there is no evidence for this and the weakest place in a fibre is always at the ends, as the necessary soldering of the fibre leaves them weak. It is therefore uncertain whether a fibre frame of the same coefficient of thermal expansion as the fibre itself would be a sufficient precaution to prevent the recurrence of the trouble. It may be found necessary to use stronger fibres, but there is difficulty in obtaining platinum ones fine enough to give the required sensitivity.

Considerable time was spent in taking down the instrument in order to increase the tension of the spring that governs the explosion recorder. Climatic conditions on the way out, or the cold, or condensation in the tent had made it too weak, when unadjusted, to release the recorder when the circuit was broken by explosion or otherwise. On a few occasions the drum that carried the photographic film failed to rotate and had to be loosened and oiled. In all other respects the seismograph behaved satisfactorily and it is hoped it will shortly yield successful results after incorporation of some of the above suggestions. In conclusion, the Expedition would like to thank the Royal Society and the Royal Geographical Society for their generous loan of the instrument, and Imperial Chemicals, Limited, for gifts of explosive and detonators.

[*Note by Editor G.J.*—The above report marks the end of the third stage in the trial of this instrument. It will be remembered that the German expedition led by the late Dr. Alfred Wegener obtained some interesting results with a seismograph of the mechanical type at the Central Ice-station in Greenland, described by Dr. Sorge in the *Journal* for April 1933 (vol. 81, p. 333). This method requires heavy charges of explosive, too great for convenience in sledging. With the aid of a grant from the R.S. and the R.G.S. a seismograph of the electrical type, made by the Cambridge Instrument Company, was sent with Mr. Brian Roberts's expedition to Iceland in 1932. No success was obtained, owing to mechanical troubles. It remained doubtful whether these troubles were inherent in the design, or due to inexperience of the observers.

The second stage comprised field experiments at Cambridge conducted by Dr. Bullard and Mr. Oliver Gatty in 1933. Defects in the electrical design were discovered and made good; Mr. Gatty became thoroughly experienced in the use of the instrument in a temperate climate, and obtained promising results.

On the third stage, in Spitsbergen, the instrument failed through differential contraction of the frame and fibre, thus loosening the fibre and damaging it or its metallic coating. Since the instrument came back it has been in the hands of its makers again, and they have redesigned the fibre frames, which have passed tests at the Cambridge Low Temperature Station, which are believed to be satisfactory.

The instrument has now been lent to the Cambridge Department of Geodesy for further research by Dr. Bullard, who proposes to try whether the earth-wave may be obtained by dropping a weight instead of by an explosion.]

APPENDIX III: METEOROLOGY

J. S. Benson

Since meteorological observations have been taken in Spitsbergen for a number of years, the results obtained by the expedition are of little value except in so far as they show the conditions experienced by the various parties. Observations

were taken by all the main parties, but not at regular times, and there were two breaks in the Base sequence of the observations when the occupants were away on supporting parties. The Coastal Survey party took their observations at 6 a.m., noon, 6 p.m., and midnight. These were the only observations taken at fixed hours. Party B generally took their observations between 6 a.m. and 8 a.m. in the morning and between 7 p.m. and 10 p.m. in the evening. Party A took them at all hours, usually taking at least three observations per day. The Base observations are practically confined to the interval between 11 a.m. and 2 a.m.

The observations of the Base and Coastal Survey parties were taken at sea-level. At Treurenburg Bay they were taken at a height of 220 feet, and at the camp 7 miles up the Duner Glacier the height was 1100 feet. The approximate average height of the inland ice is 3100 feet, and of Garwood Land about 2300 feet.

Included with the results of Party A are the results of the Depot party, which left Treurenburg Bay on July 13, crossed the inland ice to the Lomme Bay Glacier, and returned to a point about 9 miles up the Duner Glacier on July 29. Here they met the party which had remained at Treurenburg Bay until July 23, and then camped until July 29 at a point about 7 miles up the Duner Glacier. The results of this party are included with those of Party B. On July 30 the parties split up. Party B went ahead, reaching the Lomme Bay Glacier on August 17, and the Base on September 1. Party A, after keeping slightly to the east of Party B's course, reached the Lomme Bay Glacier on August 25, and the Base on September 10. From this it will be seen that there were continuous observations on the inland ice from July 15 to August 25, and a series of observations from August 17 to September 10 in Garwood Land. The Coastal Survey party started their observations at Mossel Bay on July 10 and continued them as they travelled up Wijde Bay to the foot of the Mittag Leffler Glacier until September 2. The Base was situated at the head of Ice Fjord in Petunia Bay.

In the following tables is given a summary of the observations of the four parties. Table I gives the monthly means and extremes of temperature; Table II the monthly percentage of wind directions; Table III the monthly percentage of wind forces; and Table IV the monthly percentage of weather conditions.

TABLE I.—*Mean and Extreme Temperatures*

	July				*August*				*September*	
	Base	*Coast*	*A*	*B*	*Base*	*Coast*	*A*	*B*	*Base*	*A*
Mean ..	47·0	46·0	35·7	41·1	41·8	41·5	29·6	30·3	37·3	27·6
Highest	60	57	53	48	53	50	42	39	47	40
Lowest	42	37	24	30	33	32	19	21	27	12

TABLE II.—*Wind Directions*

	July				*August*				*September*	
	Base	*Coast*	*A*	*B*	*Base*	*Coast*	*A*	*B*	*Base*	*A*
N. ..	6	14	3	3	6	23	2	12	17	—
NE. ..	7	3	—	—	28	—	2	6	47	10
E. ..	1	1	—	—	6	—	2	4	4	—
SE. ..	—	1	3	—	—	—	2	6	—	—
S. ..	1	—	8	34	—	2	14	14	14	7
SW. ..	77	15	14	30	28	29	14	19	—	7
W. ..	2	10	18	19	—	2	30	26	—	3
NW. ..	—	44	12	12	—	25	12	11	2	13
Calm ..	6	12	42	2	32	19	22	2	16	60

TABLE III.—*Wind Forces*

	July				*August*				*September*	
	Base	*Coast*	*A*	*B*	*Base*	*Coast*	*A*	*B*	*Base*	*A*
Calm ..	6	12	42	44	32	19	22	19	26	60
Light ..	55	60	33	56	42	45	44	56	53	10
Moderate	39	28	25	—	26	36	32	25	21	30
Gale ..	—	—	—	—	—	—	2	—	—	—

TABLE IV.—*Weather Conditions*

	July				*August*				*September*	
	Base	*Coast*	*A*	*B*	*Base*	*Coast*	*A*	*B*	*Base*	*A*
Overcast	28	23	20	—	23	5	19	66	55	10
Fine ..	33	—	23	—	9	—	8	10	10	37
Clear ..	—	13	23	—	3	9	23	39	40	—
Drift ..	—	—	5	—	—	—	6	8	—	—
Sleet ..	—	—	3	—	—	—	2	—	—	—
Snow ..	—	3	7	—	1	2	18	28	5	13
Rain ..	17	15	—	—	17	17	10	2	20	10
Blizzard	—	—	—	—	—	—	6	8	—	—
Mist ..	33	3	28	—	10	5	65	45	5	50

The temperatures were recorded by sling thermometers, and as there were no maximum or minimum thermometers the highest and lowest temperatures in Table I do not represent the extreme temperatures experienced, but only the extreme temperatures recorded at the times of the observations.

From Table I it will be seen that the mean temperature of the Base and Coastal Survey parties did not differ very greatly. The temperature for August was about the average, the normal at Green Harbour being 41° F. The difference between the mean Coastal Survey and Inland temperatures as recorded by Party A is fairly constant, being 10·9° F. in July and 11·9° F. in August. In most cases temperatures of over 50° F. were recorded with light southerly winds, fine weather and high pressure, but were followed by a well-marked depression. In August temperatures of 32° F. or less were recorded by Party A at 68 per cent. of their observations, and by Party B at 71 per cent. of their observations, although Party A had a lower average temperature for this month.

At the Base in July the prevailing wind was SW., in August both SW. and NE. were recorded at 28 per cent. of the observations, and in September NE. prevailed. In the first eleven days of August SW. was recorded at 32 per cent. and NE. at 9 per cent. of the observations, and in the last eight days SW. at 21 per cent. and NE. at 50 per cent. of the observations. In Wijde Bay NW. prevailed in July and SW. in August. At Treurenburg Bay between July 13 and 22 S. winds were recorded at 50 per cent. of the observations, and between July 25 and 28 at the camp 7 miles up the Duner Glacier, SW. was recorded at 75 per cent. of the observations. On the inland ice in July and August W. was the prevailing wind.

The only anemometer on the expedition was used by Party B. The Base party recorded the force of the wind on the Beaufort scale and the other two parties devised scales of their own.

In Table III "Calm" indicates forces from 0 to 2 miles per hour, "Light" from 2 to 15 m.p.h., "Moderate" from 15 to 35 m.p.h., and "Gale" above 35 m.p.h. If Tables II and III are compared it will be seen that the percentage of calms in Table II does not agree with those in Table III. This is because on

many occasions winds of less than 2 m.p.h. were recorded with the direction. Thus the figure in Table II indicates only the percentage of observations on which there was no wind at all.

Party A was the only party to record a gale, and this was in August. Gales were experienced on the inland ice by both parties several times in between observations.

On the whole the August winds were stronger than those in July. In July calmer weather was more prevalent in the north than in the south.

"Clear" implies absence of mist, haze, or shimmering at ground-level. "Fine" implies clearly defined high cloud with less than 50 per cent. of the sky covered.

Inland the most outstanding feature was the frequent occurrence of mist. In August Party A record it at 65 per cent. of their observations and Party B at 45 per cent., whilst Party B record 78 per cent. days in August on which mist was experienced at some time or other. At times these mists were very dense, frequently reducing visibility to less than 10 yards. Though Party B only record these dense mists at altitudes above 1500 feet, Party A experienced them at low and high altitudes alike. When Party B were going up the Lomme Bay Glacier they frequently saw thick cloud covering the inland ice whilst they were having fine weather, as they got higher up the glacier however they had two days with low cloud and at the top of the glacier they got into the dense mist again and they did not get out of it until they reached the Mittag Leffler Glacier. The Base and Coastal Survey parties experienced little mist in August, but in July the Base party had more than any of the other parties. At times the drift was thick and on several occasions the tents were drifted up to the top on the leeward side.

The first blizzard was experienced by Party B on August 5. This was preceded for three days by very steady pressure, and it only dropped very slightly when the blizzard arrived. The blizzard was accompanied by a rise of temperature and a SW. wind reaching gale force at times. At Treurenburg Bay at the same time Party A record a westerly gale with rain and mist, whilst the Base were experiencing fine weather and a fresh SW. wind. The second blizzard was recorded by both sledge parties on August 9, and lasted with Party B until the 10th. Rising pressure, falling temperature and a westerly gale accompanied this. The Base and Coastal Survey parties both record rising pressure and falling temperature, but at the Base there was a strong NE. wind and on the Coastal Survey there was a NW. wind. Party A record a third blizzard on August 15 with similar conditions. Party B, who were still on the inland ice farther south, only record mist, snow, and a moderate wind from the west. The Coastal Survey Party also had rising pressure and falling temperature. This blizzard followed a very sudden drop of about 0·5 inch in the pressure, which was recorded by all the parties.

Mirages were frequently seen inland. On one occasion on the Lomme Bay Glacier there appeared to be an ice cliff stretching right across the glacier with its face up the glacier. Though there is no record of Fog Bows, Party A saw them on several occasions. On the way home when in the Norwegian Fjords a Lunar Rainbow was seen. On July 15, at Treurenburg Bay, a Mock Sun was seen. Solar Haloes were seen frequently on the sledging parties. No Aurora was seen in Spitsbergen as it was too light at night, but there were some good displays on two nights on the way home between Bear Island and Tromsö.

No ice was encountered by the expedition when on the *Isbjorn*, but the pack was plainly visible on the horizon from the Duner Glacier in the middle of July. In Petunia Bay there were a great many small bergs from the Nordenskiöld Glacier when the wind was blowing into the bay. On September 14 a thin

covering of ice was formed on the sea at the head of Petunia Bay, but soon disappeared when a breeze got up. If the conditions which were experienced are normal it would appear that July is the best month for carrying out survey work as there is too much mist in August. July is also the warmer month.

APPENDIX IV: MARINE BIOLOGY

F. C. STOTT, B.SC.

The marine biological observations concern the region at the head of Klaas Billen Bay near the sea-face of the Nordenskiöld Glacier in West Spitsbergen. Klaas Billen Bay has a typical fjord formation and communicates with the Ice Fjord over a shallow ridge. The region we were concerned with was about 60 miles from the open sea.

1. *Hydrography.*—In the nine weeks of our stay 240 sea temperature and 117 salinity determinations were made, which showed that these inner fjord waters consisted of two layers: (*a*) A "light" layer extending from the surface down to about 50 metres with positive temperatures and a salinity of less than 34·5 per cent. The water of this layer was the result of the mixing of sea-water with the drainage waters of glaciers and floating ice heated up by the summer sun; (*b*) a dense layer from about 50 metres to the bottom with negative temperatures and a salinity of about 34·5 per cent. This is typical Arctic water.

A set of routine observations taken about 70 yards from the sea-face of the Nordenskiöld Glacier showed no signs of an upwelling of bottom water there. By September 11 vertical circulation due to the cooling and sinking of the surface water had started, resulting in a renewal of the nutrient salts available for photosynthesis in the upper layers of the sea. Ninety-four phosphate determinations were made and, as would be expected in a region which had had continuous daylight since the beginning of April, the upper 20 metres of the sea were practically without phosphate, and the 50-metre layer had no more than 18 milligrams P_2O_5 per cubic metre. In the deeper parts of the fjord, at 125 metres, values of about 35 milligrams P_2O_5 per cubic metre were obtained. One interesting feature was the finding of high-surface phosphates (about 10 mgs. per cubic metre) due to bird faecal matter near a bird-feeding zone at the front of the Nordenskiöld Glacier.

The vertical circulation observed on September 11 resulted in the spreading of phosphate from the deeper layers to the upper 20 metres.

2. *Plankton.*—About fifty tow-nettings were made chiefly at the surface. The dominant forms were, *Aglantha digitale*, *Pleurobrachia sp.*, *Calanus finmarchicus*, *Calanus hyperboreas*, *Sagitta elegans*, *Clione limacina*, and *Margarites helicina*. Close in to the shore were swarms of *Mysis oculata*, and in a bird-feeding zone near the glacier were thousands of the Euphausid, *Thysanoessa inermis*. The latter was a remarkable find, since this animal normally lives well below the surface. Its surface swarming in this particular zone seems to be correlated with the presence of a fine suspension brought down by a main drainage stream of the glacier. A small "light-tight" zone is thus created in which light sensitive animals like *Thysanoessa* can rise to the surface. As Mr. C. H. Hartley has shown, of all plankton animals *Thysanoessa* was the most important quantitatively in the food of birds, and it undoubtedly occupies a unique niche in the animal ecology of Spitsbergen. In a sample of 252 *Thysanoessa*, the size ranged from 15 to 29·5 mm. with the majority 24 mm. long. Thirty-five per cent. were males and none of the females were in the breeding condition. They are much larger than the same species in more southerly latitudes.

My catches of *Sagitta* consisted essentially of small-sized (less than 20 mm.)

Start of E. E. Mann's single-handed open boat journey from Petunia Bay to Advent Bay

Start of depot-laying sledge party's journey across the New Friesland ice-cap

H. C. Smith with the photo-theodolite and A. S. Irvine recording

Looking up Duner Glacier to the highland ice of New Friesland from Treurenburg Bay

Chydenius Mountains south-east of the Lomme Bay Glacier

Ivory gulls on cliff near Treurenburg Bay, the first to be found in West Spitsbergen

very immature individuals together with a lesser number of large nearly mature forms which would be ready to breed towards the end of September. The small-sized individuals were probably the result of prolonged spring breeding, so that it is probable that this animal has but two breeding periods per year in Spitsbergen waters as compared with four or five for the same species in the English Channel.

3. *Benthos.*—Dredging up to a depth of 25 metres in the shore zone showed the bottom to be very sparsely populated near the glacier. Along the shores of Klaas Billen Bay there were families of eider duck which were feeding on the *Mollusca*, *Crustacea*, and *Polychaeta* in the deeper Laminarian zone.

4. *Seal and Fish.*—In the region of the Nordenskiöld Glacier seal, probably chiefly *Phoca foetida*, were plentiful in the middle of August, but they migrated early in September. They were found to be feeding on *Thysanoessa* almost exclusively.

The butter-fish, *Leptoclinus maculatus*, the sucker-fish, *Liparis liparis*, and the bullhead, *Myxocephalus scorpius*, were all fairly abundant in the offshore dredgings, but in spite of the co-operation of the Royal Engineers and dynamite, no larger and more edible fish were obtained. A single small specimen of the Arctic cod, *Boreogadus saida*, was obtained.

The interrelations of the plant and animal communities in Spitsbergen have been described in some detail by Elton (*Journal of Ecology*, vol. 16, 1928), and an account of the marine foods of the birds should provide an interesting and important link in elucidating the food chains of typical Arctic communities. Of the observations previously mentioned the finding of a bird-feeding zone close to the Nordenskiöld Glacier is of greatest interest. In the nine weeks of our stay at Bruce City we found the bird population to fluctuate considerably in this zone. The amount of water melting off the glacier is proportional to the air temperature, and we found a good correlation to exist between the size of the detritus-laden zone and air temperature. On August 22, after a spell of warm weather, the "brown" zone was very large, the bird population numbered some four thousand and was feeding at a very fast rate, showing the abundance of *Thysanoessa* at the surface of the sea. Hydrographic observations at the time showed the salinity near the glacier to be the lowest recorded and the surface phosphate the highest. On September 5, after a cold spell, the "brown" zone could not be seen 70 yards away from the glacier, and there were only a hundred or so birds which were feeding very slowly. The surface salinity near the glacier was high and the phosphate low.

It is probable that feeding zones occur at the faces of all Spitsbergen glaciers abutting on the sea, so that the most important quantitative food relation between the land and sea is concentrated in quite small but intensely active areas.

APPENDIX V: BIRD ECOLOGY

C. H. Hartley

The original scheme of work included a census over a relatively large area, and an investigation of the food of all marine feeding species, the ultimate object being to discover the part played by the bird population in the general ecology of Klaas Billen Bay. The discovery of the feeding zone at the Nordenskiöld Glacier caused considerable revision of the general scheme, since it was felt that the zone warranted a detailed study. Apart therefore from a short trip to Gyps Hook and an expedition by Fisher to Wijde Bay, all the ornithological work was carried out in the Adolf Bay district.

The actual feeding zone was an area about 100 yards long and 50 yards across,

close to the ice cliffs of the glacier at a point roughly midway from either shore. The birds feeding were Kittiwake and Fulmar, the normal numbers being about 3000 Kittiwake, and 500–700 Fulmar. The zone during July and August was a permanent feature, though Fulmar numbers at times varied considerably. The birds rested on the water and in feeding were never seen to up-end, and seldom to immerse much of the head; but in spite of this the rate of feeding, which was noted on each occasion the glacier was visited, was relatively rapid, a bird in the middle of the flock pecking on an average three times a minute.

The Kittiwakes appeared to be coming from bird cliffs on the south shore of the fjord and near Skans Bay. The main flight lines passed close to the point of the southern lateral moraine of the Nordenskiöld and then over Cape Napier and Bruce City: a fact which was of great convenience to us in all our observations, and incidentally simplified the catering problem. Observations on the number of birds passing for half-hour gave no regular correlation with weather conditions, or with the less bright period of the twenty-four hours which passed as "night," but there did appear to be a broader correlation between the total number of birds present in the zone and the air temperature.

Observations on the quantity of food taken were carried out during the early part of August before the young Kittiwake were fledged, by intercepting birds returning to the colonies *via* Bruce City. Analyses of a large number of stomachs showed that the food was almost entirely the Euphausid *Thysanoessa inermis;* though an amphipod, Euthermists *libeltala*, occurred occasionally in small numbers. The average meal was in the neighbourhood of 330 euphausids; small fish, which are reported to form the main item of diet off the north coast of Spitsbergen and North East Land were, in Adolf Bay, of extremely rare occurrence in the stomachs not only of Kittiwakes but also of Fulmars and Terns; there thus appears to be a notable shortage of them in the inner fjord zone.

Stomach analysis of other marine feeding species revealed that *Thysanoessa* was the basic food source of Arctic Terns, Fulmars, Brunnicks, Guillemots, and little Auks. It figured largely in the food of Puffins, though these appeared to be fish-eaters to a certain extent, and Manit's Guillemot, which also fed in the inshore zone on the general bottom fauna. Only in the case of the Northern Eider, another inshore feeder, was it completely absent. It is therefore clearly of the greatest importance to the bird population of the island; but since it is not normally found in the extreme surface layer owing to its susceptibility to light, under normal circumstances it would not be available for capture by the non-diving birds. Hence the effect of the glacier is of the greatest importance to this section of the bird population, indeed, considering the apparent scarcity of small fish, it is probable that but for the glacier Kittiwakes would not be found at all in the inner fjord zone.

APPENDIX VI: RATIONS AND EQUIPMENT

A. R. GLEN

(1) The sledging rations per man per day were as follows: 8 ozs. Bovril Pemmican, 4 ozs. Van den Bergh Margarine, 4 ozs. Cadbury's Chocolate, 4 ozs. Tate and Lyle granulated sugar, 5 ozs. mixture Quaker Oats and Plasmon Powder. Also small quantities of Lyons concentrated lemon juice; dried yeast prepared by Distillers Co.; cod-liver oil prepared by Fairbanks Kirby; and a salt mixture.

These rations were used by the two sledging parties and by the coastal survey party. They were also used, but without the vitamin-containing extras, by the Dickson Land party and by the base depot laying party. The health of all

members of each party remained very good, and the ration can on the whole be described as satisfactory.

In the choice of rations it is all-important that full consideration be given to whether the party is equipped with dogs or is a man-hauling party. It is also important that the variation of Arctic summer and winter climates be fully allowed for. In the case of a dog-sledging party, the above ration would be more than adequate, but it could not be cut down for a man-hauling party.

Two conclusions were reached concerning the use of these rations under summer Arctic conditions. Biscuit was badly missed, and 4 ozs. per man per day of Plasmon hard wholemeal biscuit is suggested. Variety can be introduced by taking brown, white, and barley sugar, and different kinds of oats as well as of chocolate. Some toffee ought also to be taken.

The first depot-laying party, setting out almost immediately after being landed, took no lemon juice on its sixteen-days' journey. A certain amount of vitamin C shortage was felt, but this disappeared immediately when they started taking the lemon juice on return, although they were still doing the same amount of work.

(2) The food used by the Base party was the ordinary English diet. In Klaas Billen Bay fresh meat can always be obtained at the Nordenskiöld Glacier face, where seals and bird life are plentiful. For boat journeys bacon is excellent and a good amount ought to be taken. Plain corned beef was found to be more popular than such foods as tinned pies, etc., but a larger proportion of carbohydrates is required if non-active work, such as that of Bruce City, is being done. Fresh bread was only made after the return of the northern parties, and was much appreciated. A full-time cook ought to be taken on an expedition with a large personnel.

(3) Nansen sledges were used and were found excellent in every way. They ought to be well soaked with linseed oil some time before leaving, and it was found that it is well worth waxing their hickory runners. Decking and the fitting of handle-bars increase their efficiency. Ordinary climbing rope is probably as good as anything for lashings and harness ropes. The Shackleton-pattern harnesses were too short for tall men, and it is important that they lie easily round the hips. Pyramid tents manufactured by Messrs. Camp and Sports were used and proved excellent: a coastal party in Spitsbergen however requires a rainproof tent. The temperatures were not so low as to necessitate the use of *finnesko* and the hairless Lapp-boat would be better for camp work.

(4) The general equipment of the expedition was good, except in the matter of boat stores. Sailing conditions in Ice Fjord and Wijde Bay were found to be very good, and properly rigged semi-decked whale-boats would have helped. The outboard engine proved very satisfactory and gave remarkably little trouble. Large amounts of pitch, paint, copper nails, etc., are essential.

In conclusion I would like to thank the many people who helped in the choice of equipment, and in particular the thanks of the expedition are due to Dr. S. S. Zilva, of the Lister Institute of Preventative Medicine, who worked out the rations and who was ready to help us at any time.

DISCUSSION

Before the paper the PRESIDENT (Major-General Sir PERCY COX) said: You will, no doubt, all have heard of the Oxford University Exploration Club; it is under the auspices of that Club that the Oxford University expeditions are organized. But they are not confined to Oxford men, and the expedition about which we are to hear this evening included several Cambridge men. Mr. Glen will tell us its precise composition. He himself is an undergraduate of Oxford

University, and led the expedition. Mr. James Martin would have been the leader but, unfortunately, while on an expedition in Canada prior to the starting of the expedition to Spitsbergen, he got frostbitten in the feet and was so long in hospital that he was unable to go with the party; nevertheless, he remained in England at the head of the expedition's affairs, looking after its interests and business at this end.

The exploration of Spitsbergen has been of special interest to the Society for a number of years past, and so long ago as 1896 our distinguished Fellow, Sir Martin Conway, now Lord Conway of Allington, wrote a book on the exploration of Spitsbergen dealing with the subject practically "from the year One to the present day." Since then a number of small expeditions have taken place. To-night we are to hear about the New Friesland ice-cap in the north-east of the main island of West Spitsbergen. The expedition was extraordinarily complete in its composition, science being represented in the spheres of geology, biology, and ornithology, and carried on its operations in three parties. But I do not wish to entrench on Mr. Glen's own explanations and will ask him now to read his paper.

Mr. Glen then read the paper printed above, and a discussion followed.

The PRESIDENT: Mr. Fleming, will you now come and address us? Mr. Fleming, who is Chaplain of Trinity Hall, Cambridge, was the leader of sledge party A, and one of the geologists with that party.

Rev. W. L. S. FLEMING: The work of sledge party A, as Mr. Glen has pointed out, was principally that of making a geological and topographic survey of the northern part of New Friesland. We were very disappointed that we could not make better use of the photo-theodolite which we had with us. The instrument weighed a great deal and added considerably to the sledging loads. If only we had had finer weather and better sledging surfaces we should have been able to produce a very accurate map with this most excellent instrument; but, as it happened, we would have secured perhaps as good results with a plane-table. We did not have as many days for our scientific work when we were not sledging as we had hoped. The surfaces were soft and, as it seemed to us after a few weeks' work there, Spitsbergen was all uphill. On the days when we were not travelling we spent our time in geologizing and surveying. The two geologists of the party were somewhat more fortunate than the surveyors inasmuch as they could see rocks on days when the surveyors could not see sufficient distances to get their photographs and make sun shots for their latitude and longitude sights.

The geological work was particularly interesting because there are in New Friesland the bevelled roots of a mountain system, possibly of the same age as the Caledonian mountain ranges of Scandinavia and the Highlands. No fossils have been found from the rocks in New Friesland, so that the exact dating of them is impossible. But from the fact that in Bear Island rocks of similar kind to those in the east of New Friesland contain early Palaeozoic fossils, it seems likely that the latter are of the same age. In the eastern part of New Friesland the rocks have been thrown into folds by Earth movements, and in the western parts they have been injected by a lot of igneous material and are very much more complex.

The whole of the interior of New Friesland is covered by a vast sheet of ice. It is not really an ice-cap inasmuch as the surface of the ice does reflect in some degree the underlying topography. The top of the ice-sheet, instead of being level, consists of a number of gently arched domes, some of them 7 or 8 miles across. The depressions between the domes on the summit probably marked the site of preglacial valleys underlying the ice. The ice flows out, in some cases

by normal glaciers flowing at a fairly constant gradient towards the sea; but some of them head in steep-sided ice-corries from which they plunge down steeply and then flow as normal glaciers between precipitous rock walls towards the sea. The surface of the lower parts of these glaciers is very uneven and dissected into a number of hummocks, except in some places near the margin of the glaciers, where there are smooth lanes of ice overlying buried moraines. The latter were useful to us in sledging, because the hummock-ice was very bad going.

In sledging down to these glaciers we sometimes used the most unorthodox methods. On one occasion, when we were going down a glacier that descended some 1600 feet, we decided to let the sledges do their own work and make a series of traverses by pushing them from side to side down the glacier. We unharnessed a sledge, pushed it off, and then had the amusing if somewhat alarming sight of watching it do a beautiful corner, swing down the glacier, and disappear out of sight at a speed of something like 30 or 40 miles an hour. The sledge when we skied up to it was all right but had come to rest about 50 yards above a steep ice-hummock slope on which it would certainly have capsized and possibly have been smashed to pieces.

We arrived back at the base on the last day on which we had been expected. We all of us felt extremely fit, which is, I think, a sign of the excellence of the rations which had been selected for the party. There is only one grudge I have against them, and you will bear with me when I say that for six weeks we had one spoonful of cod-liver oil every day, for cod-liver oil has the property of making its presence known when you are not actually taking it. It got over everything. I am afraid we were not as conscientious as we should have been, and on the journey home we jettisoned a large tin of cod-liver oil, which is now majestically riding down the Lomme Bay Glacier towards the sea.

Gatty and I during the last week or two had a very interesting time investigating the polygonal surface markings. In the Arctic and in the higher parts of the Alps and Himalayas, and, in fact, in all alpine climates, you will find on the surface of the ground that the weathered material has been sorted to form a network of polygons. Each polygon is about 40 inches across, and consists of clay or fine material surrounded by a narrow rim of stones or boulders. One of the chief factors in the formation of these polygons is the alternate freezing and thawing of water near the surface.

We were still enjoying ourselves studying these polygonal surface markings when the *Isbjorn* came for us and we left for home.

The PRESIDENT: Mr. Hartley was the biologist and ornithologist to the expedition. I will ask him to address us. You will realize the extraordinary difference in the type of country he was now dealing with from the ornithological point of view as compared with that of Sarawak.

Mr. C. H. HARTLEY: We went out with rather fluid plans because we did not quite know what conditions we were going to encounter, but it was hoped that the ornithologists would be able to work in with the marine biologists as much as possible. The ornithological plans were mainly concerned with working out the food of the marine-feeding species, Arctic terns, kittiwakes, fulmars, and various members of the Auk tribe.

We soon discovered that the Nordenskiöld Glacier face was the central point of bird life, and accordingly moved our camp over to Bruce City. The feeding zone was extremely limited, about 100 yards long and 50 yards broad, right up against the face of the Nordenskiöld, about midway between either side. It was closely packed with birds, about 3000 being in that area, on the average, a figure which was perfectly constant throughout the whole of July, August, and up to the beginning of September. We carried out our observations as close as we

could get with safety to this area. Originally we fixed 70 yards as being the safety limit, but that was before we knew much about the glacier. Subsequently we discovered it was not as safe as we had supposed, but by that time we had fortunately finished our observations.

It was necessary, first, to determine what the birds were eating. We were able to analyse the stomachs of about 250 kittiwakes, and they all gave the same result: a small crustacean, found in immense numbers; the average meal being 350, and the record 1100. We were handicapped by losing our big tow-net—in any case it was rather risky towing in that area—so we are rather short of data on the actual distribution of the crustacea in the water. It is however quite certain that they were swarming very thickly in this area because we were able to work out the rate of consumption, which was over 4 millions a day, or rather over 3000 a minute.

In conjunction with our observations on the birds while feeding, we made hydrographical observations and soundings, and took sea temperatures for the whole period. It was quite evident that the abnormal swarm was caused by a main drainage stream of water running out of the glacier. Just at the point where the water came out there was a rock outcrop, which may have had something to do with the permanency of the drainage stream. The importance of this stream with regard to the general bird-life of the fjord was more considerable than we had first thought because there were no kittiwake colonies in the base camp area. There was a small one up the Horbye Glacier about 10 miles away, and the whole way down the coast beyond Bruce City to Gips Hook, which is the southern point of Klaas Billen Bay, there were no kittiwakes nesting at all. There was a colony at Shans Bay, but all the big colonies were the other side of Advent Bay, about 40 miles away. We followed the kittiwakes down on foot to Gips Hook, followed them with a telescope as they crossed Ice Fjord, and realized they were quite certainly coming from colonies on the southern shore, which meant that the particular glacier feeding zone was a concentration point for most of the kittiwakes from a very large area.

We then tried to determine what else, if anything, the kittiwakes might be eating. In North Spitsbergen, on the 1923 Oxford Expedition, it was reported that they were eating fish. We carried out netting as much as possible without securing any fish. We set out night lines, and even exploded 30 lb. of dynamite. On the occasion we used the dynamite we got only one fish with two explosions! So it seems perfectly clear from our observations that fish are scarce in the area, and it is the glacier water, causing a swarming of crustacea, which is responsible for the kittiwakes being in the inner fjord zone at all.

Apart from the kittiwakes we made general observations on the feeding of all Auks and, incidentally, discovered some rather interesting things about Mandt's guillemot. It feeds in the shore zone, obtaining worm and molluscs from the roots of the Laminaria, which means that it is going down at least 20 feet. It must dive right through the middle of this thick seaweed bed, since dredging revealed that the molluscs it was feeding on were only to be found near the roots.

We were not working on nesting species at all, because, apart from the fulmar, which is extraordinarily common, there are not many nesting birds to be found in the Klaas Billen Bay area; but we wanted, if possible, to get observations on ptarmigan, since we gathered that they were getting extremely rare in Spitsbergen. We did see one or two when we got there in July, but the first definite news of ptarmigan was brought in by the Dickson Land Party. In the middle of the Horbye Glacier there were ten ptarmigan with four chicks about a mile from any rock, right in the middle of the glacier, and having some difficulty with crevasses. That did not prepare us for the surprise we got when, quite suddenly,

in September the place became alive with ptarmigan and Bruce City fed royally on them for about ten days. They had evidently been nesting in numbers on the mountain tops, and had come down at the approach of the cold weather.

During September the weather became much colder and the glacier stream subsided on September 5, when we could not notice any current flowing. The birds had then practically disappeared. About September 9 there was a warm spell for a few days; the stream was again running, and back came about one thousand birds. I am quite certain that if we had been able to obtain regular records of the numbers with a certain amount of lag they would have fitted in pretty well with the other data. We were unable to get photographs every day we went up because we had to go up in bad as well as good weather conditions. After September 9 the weather got cold again and the birds practically disappeared, and for the last week of our stay we really had no more work to do, so we contented ourselves with entertaining our guests from New Friesland till the arrival of the *Isbjorn*.

The PRESIDENT: I now call upon Mr. Geddes, who was with the Coastal Survey Party.

Mr. A. C. GEDDES: I would like to say that this is the first intimation I have had that I would be asked to speak to-night. I was the one who lived in Mossel Bay while Greenwood and Gregson were starting the survey. That was an experience which sounds nothing at all: it was just five days alone by yourself! But when you have never been in that position before it is really rather interesting: you seem to get to know yourself. The chief joy of that place was the birds. The island on which I was and where the other two joined me was an eider-duck colony; within 3 or 4 yards of my tent there were birds nesting. All night long they kept me awake with their gossip, though of course we really had no night; it was always broad daylight. In fact, at times we got rather out of step: we worked by night and slept by day; but that did not make much difference, except to the photography. As we progressed down the coast we went from one type of bird to another: we left the eider-duck and came to more sea-birds and more kittiwakes. They were exceedingly interesting because they were live things. It is all very well to study rocks, but people and animals are really much more interesting.

Our method of progression was extremely tedious. We had two boats, both very heavy—only those who tried to lift them out of the water knew how heavy—and we had about a ton of gear all told. Every time we wanted to land we had to get the gear out of the water and the boats also, because we never knew when a storm would come up and we could not, of course, risk losing the boats. Therefore we made as few moves as possible and stayed as long as possible. We started out very early in the morning, each of us rowing for an hour and taking half an hour off. We rowed for eight hours altogether, and then in the evening we would lift the boats out of the water and go ashore. It was a grand life, which those who have not experienced it cannot fully appreciate. One of our greatest joys was meeting the trapper. He did not speak English, and we spoke not a word of Norwegian. However we discussed everything, including geography, astronomy, and philosophy.

The day we climbed the Stubendorff mountain—I do not think anybody had ever climbed the mountain before—we did not know how high it was, though of course we knew it was a big sort of mountain. All the mountains there are so well proportioned that they look perfectly superb alpine peaks, beautifully coloured by the frost and streaked with snow, with glaciers flowing down between them. As we climbed it was very cold. When we reached the top we took a whole series of photographs, but suddenly we saw clouds coming round underneath

us. We stayed on the mountain to see the effect of other mountains being blotted out, and gradually our peak was left with an amphitheatre of peaks standing out round us. Then we found it was becoming too cold, so we dived down into the murky atmosphere below the clouds.

Amongst our more unpleasant experiences were the mist and rain. Actually we expected snow, and our tents were double to keep it out. But, though snow-proof, they unfortunately were not waterproof, to our great discomfort.

The PRESIDENT: I will now ask Mr. George Binney to speak. He was not on this expedition, but has been on earlier ones and was practically the originator of these Spitsbergen expeditions from Oxford. He knows as much as any man of the country and the work to be done.

Mr. GEORGE BINNEY: One point of extreme interest to me in comparing the work of the expedition last summer with the 1924 Oxford Expedition, when we worked in North East Land, was the difference in the condition of the snow on the north of the New Friesland Ice-Cap as compared with the snow when we were crossing North East Land. I understand from Mr. Glen that, on the whole, the ice conditions for sledging in Northern New Friesland were good, but at heights of about 2000 feet. We found during the same period when we were crossing North East Land that the snow conditions were certainly not good. We had considerable difficulty with our dogs.

Before Mr. Glen went on this expedition he asked the advice of many people as to whether he should take dogs, and I should add that my advice was in the minority of one. I was the only person to advise him to take dogs, and he told me to-night that he wished he had done so, but, being a democrat, he had taken the advice of the majority. The reason why I advised the use of dogs was more from the standpoint of the training which it affords to an expedition which has reasonably good country to traverse, the confidence it gives to a man in having learned to drive dogs, and the greater value of his services to any future expedition where perhaps he may have to work with dogs because the distance would be too great to cover in any other way.

In 1924 we were the first Oxford Expedition to enjoy the privilege of assistance from the War Office in the shape of the loan of personnel. Thanks to Brigadier Winterbotham we were loaned a sapper officer, and ever since then the War Office has given assistance to University expeditions. It is a very satisfactory and pleasant feature of University expeditions that they should enjoy the technical support and co-operation of Army officers.

Finally, from some experience in handling expeditions such as Mr. Glen handled last summer, I should like to congratulate him on the organization work connected with his expedition. He had the responsibility of co-ordinating the efforts of four units, each one of which successfully completed its task.

The PRESIDENT: Our veteran Fellow, Dr. Longstaff, knows as much about this part of the world as he does of the Himalayas. I will ask him to wind up the discussion.

Dr. T. G. LONGSTAFF: I should like to sympathize very much with Mr. Martin that frostbite rendered him unable to lead this expedition, but we can congratulate the Oxford University Exploration Club and Mr. Glen on a very successful undertaking. I had the privilege of being with the first Oxford University Expedition in 1921, and with Mr. Binney's expedition of 1923, and I do not think such expeditions are quite as simple as Mr. Glen makes out. His expedition was very well organized: the co-ordination of work was excellent.

I want to draw particular attention to a point which is very important in these expeditions. Mr. Glen has adopted the principle of convergence to his "get-away"—to his point of departure. He really had four parties out, but they were

all put out at the beginning and they all converged in to one point. That is the way to avoid accidents and catastrophes; otherwise the risk of not being able to pick up some party is great. It is a very good principle indeed. It is only, of course, by having numerous parties out that one can in a short season examine a large area of country.

A remarkable point is that I observe from the photographs that a great change has taken place in the Nordenskiöld Glacier. I went up there with Mr. Odell, who is here to-night, and his party in 1921, when we made the first crossing of the main ice-cap many miles south of where Mr. Glen and his party were working. Day after day we saw that Nordenskiöld Glacier, and I took a series of photographs of it which are deposited with the Society. You will find on comparing them with those shown by Mr. Glen that the ice has weathered; that the glacier has not so much retreated as become thinner; the ice-face is not so high; the glacier has definitely shrunk.

Having had to compete with such sledgers as Odell and Frazer I know well what summer conditions in these regions are. A man cannot pull more than 200 lb. on a soft surface. The photo-theodolite and the echo-sounding apparatus weighed some 600 lb. I have the most unbounded admiration for the men who pulled such weights. Mr. Glen indicates that the plane-table is more serviceable for such work. Certainly the Dickson Land party attained a very remarkable mobility and effected an admirable survey of a considerable area in a very brief, though I am certain a very strenuous, campaign with the plane-table.

You will note that the first time they tried the outboard motor on the way down Ice Fjord to Sassen Bay the engine failed. They proceeded to raise mast and sail, and when that was insufficient took to their oars. As a result they did 50 miles in a day, which I think you will agree was fast enough for anybody.

The whole expedition is a credit to the Oxford Exploration Club, to Mr. Glen who organized and led it, and to his team. Personally I look forward to seeing their maps of this most interesting region and to their more detailed reports, which will appear in the specialist journals.

The PRESIDENT: I know you will all agree with me that we have had a lecture of extraordinary and varied interest. It is gratifying in the extreme to see the Universities sending out these splendid young parties, and the wonderful work they do. We have heard to-night of valuable results achieved in surveying, geology, biology in general, and ornithology in particular, and it has also been most satisfactory to know that expeditions such as this have the support of great commercial institutions like Imperial Chemical Industries, who are prepared patriotically to support serious projects such as that about which we have heard. We cannot too highly congratulate Mr. Glen on the results of the expedition and on the way it was led. I ask you to join me in thanking him for a most interesting lecture.

THE GLACIOLOGY OF THE ULLSWATER AREA

THOMAS HAY

FOR several years I have been occupied in examining and mapping the glacial features of this north-east quarter of the Lake District. During many foot journeys in every direction over the 56 square miles of this diversified area it has been possible to make observations on glacial problems, some of which are still matters of varied opinion. The results of this examination are embodied in the present paper, and it is hoped that this short account may fulfil a threefold object. In the first place fresh observations have been made which may interest the expert, and an effort has been made to show their bearing upon several problems of great interest. Secondly, the general account may be of service to some readers who are fond of physiography without being glacialists of experience; and thirdly, the accurate details may serve as a help to those students and walkers who want to explore for themselves.

The main conclusions are:

1. The highest land was glaciated and not merely covered with névé. There are erratic boulders up to a height of 2750 feet. There is a Gravelly Mountain Drift on such places as the Helvellyn Dods. There is hard compact boulder clay up to 2370 feet.
2. There were two glaciations. Two distinct boulder clays are found separated at intervals by patches of gravel and clay. The separation can be traced over $2^1/_2$ miles.
3. Ice crossed high ridges up to an elevation of 2230 feet.
4. During the period of deglaciation, the edge of the Lake District ice-sheet in its retreat from outside towards the centre, on reaching the Ullswater area, did not preserve a united front but broke up into separate patches according to the nature of the ground.
5. The parts to be cleared first in the lower reach of the main valley were the lower slopes of the fells between 600 and 900 feet, but at that time there was no such separation in the upper part of the main valley.
6. Ice seems to have remained stagnant in the lowest reach of the valley, as is shown by esker-like deposits there.

Other conclusions there are, which will be dealt with later on, but some explanation must now be given of the preceding points. It will be convenient to take them under the numbers shown above.

1. The late Professor Marr, whose influence and inspiration are so great in all matters touching Lakeland geology, has stated that before the glacial epoch the hills of this district were in a state of subdued relief. He instances places where this relief is still to be found, mentioning the fells at the back of Skiddaw, a hill above Hartsop at the head of Ullswater, High Street, and the western side of Helvellyn. Although the whole area was covered by an ice-sheet at the maximum of the glaciation, such tracts are held to represent the sub-aerial surface, but little modified by ice action.

Any one who has noticed the remarkable difference between the surface appearance of the craggy Cuillins and the smooth Red Hills in Skye, and who has reflected that both these groups must, on account of their nearness,

have been exposed to the same glacial processes, may wonder whether this diversity of reaction to ice action has been sufficiently allowed for. The hill above Hartsop, which is shown in Professor Marr's 'Geology of the English Lake District,' has all the rounded appearance near its summit which would illustrate the usual interpretation, but it is at the end of a ridge, and all along the whole ridge up to Little Hart Crag there are erratic boulders. So that in this case the roundedness does not exclude severe glaciation.

It has been a most interesting investigation to examine these fells for high-level erratics. Clifton Ward has dealt fully with this question in his 'Geology of the Northern Part of the English Lake District.' He mentions several examples of high-level specimens in this area and calls attention to the difficulty of being sure that boulders are erratics owing to the uniformity in appearance of the rocks.

A great deal of time has been spent in the search for high-level erratics, and only after a careful observance of all the necessary precautions has the validity of any specimen been accepted. The result is that fourteen high-level erratics have been found in this area at heights between 2500 and 2750 feet. An even higher one was found outside our area on Crinkle Crags at about 2800 feet. Nearly all these were found on the Helvellyn range between Red Screes and Raise, but one or two also on High Street.

One feels quite certain that many of the detached and angular blocks that are found on these high parts of the fells are ice-moved, but only in special cases is it possible to prove it. One very interesting case of the latter sort occurs on the very top of Little Hart Crag. This is a very rugged projection of rhyolite at 2090 feet, and on the very summit near a little dried-up pool there are three big angular blocks. Had they all been of rhyolite one would have been left in doubt as to their history, but two of them are of tuff and one of rhyolite, clearly establishing the fact that all three are erratics, and that in the latter we have one moved only a little way.

To the best of my knowledge no erratic has been recorded at a greater height than 2800 feet, but, owing to the difficulty mentioned above in the reference to Clifton Ward, it is not at all impossible that others may be discovered at a greater height.

Dr. Raistrick, in his article on "The Glaciation of Borrowdale," in the *Proceedings of the Yorkshire Geological Society*, vol. 20, says, "The nature of the weathering on such summits as the Scawfell Pikes, Great Gable, and Glaramara, is inimical to the preservation of striations, but the notably rounded forms of the summits and the smoothing off of all jagged points is evidence, certainly not so definite as scratches, but still of considerable weight."

Then there is the presence of the Gravelly Mountain Drift on such places as the Helvellyn Dods, which are typical representatives of the rounded-summit land. On the east side of Watson's Dod this drift is 6 feet deep at 2500 feet, and the top of the Dod is at 2584 feet. This drift must have come from the summit land. Again, at the head of Hayeswater Beck, there is real compact boulder clay at 2371 feet. From this point there is a fairly gentle slope up to the top of the flattish summit of Thornthwaite Crag at 2568 feet. Here again the boulder clay must be the product of the glaciation of this upper slope.

Thus a genuine glaciation of the topmost land is indicated by the following facts: The existence of high-level erratics up to 2800 feet, the presence of Gravelly Mountain Drift on much of the rounded summit land, the presence of genuine compact boulder clay at 2371 feet, and the rounded nature of such rock surfaces as those mentioned by Dr. Raistrick. This glaciation of the rounded summit land may only have been a Highland glaciation, to adopt the nomenclature of Priestley and Wright in their Glaciology Report of the British Antarctic Expedition of 1910–1913. It has not been negligible but has been sufficient to affect to a considerable extent these rounded contours even if it has left us with a surface which is substantially parallel to the preglacial surface.

2. In dealing with the question of the number of glaciations it will be necessary to describe the different kinds of drift that are found. We have:

A. Hard bottom boulder clay,
B. Looser surface deposits such as constitute either terminal, lateral, or medial moraines or merely hummocky ground,
C. Gravelly mountain drift,
D. Gravelly and sandy deposits between two boulder clays,
E. Surface gravel mounds,

and will describe them in this order.

A. The Hard Bottom Boulder Clay in the valley bottoms of the area of the Borrowdale rocks is extraordinarily tough. In excavation it has sometimes to be blasted. Except in the very north-east corner of the area the contents are all Borrowdale rocks or Skiddaw Slate. When the former rocks form the constituent materials the prevailing colour is "stone-colour," and when the latter rock is in evidence the colour is a dull slate blue. This slate-blue colour in the boulder clay is always an indication of the proximity of an outcrop of this slate rock, even when that outcrop cannot actually be found.

The upper Glenridding valley, near Keppel Cove, at the time of the construction of a dam, revealed a great variety of colour in the bottom boulder clay where it came near the live rock. During the cutting of a trench for water-pipes from Dowthwaitehead to the Penrith Reservoir at High Larches the variety of colour in the drift was most striking as one passed over Borrowdale rocks, limestone, sandy and coaly layers in quick succession. Such a rapid change of colour suggests that one is dealing with a thin layer of boulder clay even when the base is not seen.

B. The looser surface deposits form the lateral, medial, and terminal moraines that are so plentiful in all the upper parts of the valleys, and also form the floors of the combes. Every valley shows places where the stream is cutting into this material, which is so loosely compacted that the new surface works back at about an angle of 35 degrees to the horizon. This is in striking contrast to the vertical faces that frequently result from the erosion of the bottom boulder clay. In deeply eroded sections of this drift, the surface drainage sometimes cuts out a series of channels separated by fairly sharp ridges. Such a formation occurs in Red Tarn Beck and also in the part of Aira Beck above Dowthwaitehead. A similar channelling occurs at the head of some of the combes, *e.g.* the upper Glencoyne valley and above Grisedale Tarn on the slopes of the Helvellyn range.

Angle Tarn frozen over; two knob-like summits in middle distance show a fairly common local formation

Glenridding Valley: typical rounded summit in centre distance, later fractured precipitous surface on the left, great glaciated valley towards the right

Glenridding Beck about 630 feet above O.D.: stratified sand between two layers of boulder clay

Glenridding Beck: plucked surface, with drift lying above solid rock

C. The Gravelly Mountain Drift corresponds with what Dr. Raistrick has called "High Altitude Gravelly Drift" in his paper on "The Glaciation of Wensleydale and Swaledale," in the *Proceedings of the Yorkshire Geological Society*, vol. 20. This deposit is widely distributed up to a height of 2500 feet, and possibly higher. It is found in the upper parts of Keppel Cove, and there is a great quantity of it on the Helvellyn Dods. It is much more homogeneous than the other drifts. It consists of comparatively small stones and gravelly clay. The stones seem to be mainly a local product. This drift is usually covered with turf, and it swathes over many parts of the elevated land and levels up between the outstanding ribs of rocks in combe-heads. As a typical example of it we may take the hollow at the head of Browndale Beck, which flows through Cumberland Deepdale to the upper waters of Aira Beck. This combe is swathed completely over with this mountain drift. If the beck be followed down from its source at 2500 feet there seems to be absolute uniformity of surface structure and covering until at 2100 feet undoubted boulder clay is found in the banks of the beck. It is quite impossible to say where the mountain drift ceases and the ordinary boulder clay begins.

D. The gravelly and sandy deposits between two boulder clays are only to be seen under favourable circumstances and might easily be overlooked altogether. A dam at Keppel Cove belonging to a local mining company burst in 1927. Another near the same place followed suit in August 1931, and this was again followed in November of the same year by perhaps the worst natural flood that has happened in this district for thirty years. These three floods in the Glenridding Beck tore away so much matter from the stream banks that glacial deposits were revealed in a noticeable degree. Masses of turf, peat, boulder clay, and river material were scoured off in some places and deposited in others. Fresh sections were revealed which however in the short lapse of time since then have already deteriorated. Several of these sections showed stratified sand or gravel or laminated clay between an upper and a lower boulder clay. These intermediate layers were not continuous, but they occurred at intervals along the course of the beck from 600 feet right up to 1700 feet above O.D. Their thickness might be only a few inches, but in most places it was about 2–3 feet, never however exceeding 5 feet.

E. Another gravelly deposit occurs at Castlehows Point on the west side, and at Hodgson Hill on the east side of the lowest reach of Ullswater. These gravelly mounds lie near the courses of becks at the present day, and probably are eskers formed by the filling in of stream beds or crevasses in stagnant ice.

The paragraph *D* will have shown that there are two boulder clays to be found in this area. The two boulder clays are entirely formed of local rocks, and there is no means of distinguishing them by difference in their petrological content. Unless something in the nature of a sequence is observed it is not always possible to tell to which boulder clay any particular section may belong. Along the course of the beck in question, six well-marked examples occurred where the three layers were quite clear: (1) Upper boulder clay; (2) sand, gravel, or laminated clay; (3) lower boulder clay. There were several more sections where it was quite possible to distinguish the upper and the lower boulder clays without the presence of the intermediate layer. The lower boulder clay is harder, and as a rule has smaller pieces of rock and boulders in

it. It often consists very largely of the native rock immediately beneath, and therefore is rather variable in colour. The upper boulder clay is not so hard, and as a rule is "stone-coloured," to use a painter's term. It has larger boulders in it than the lower boulder clay and a bigger proportion of rounded boulders.

A gradient of 1100 feet in 2^{1}_{2} miles hardly provides a terrain in which melting *in situ* would be likely to explain the threefold arrangement, and it seems much more probable that we have here evidence of two glaciations rather than of a mere fluctuation.

3. Sheffield Pike, just west of Stybarrow Crag, stands up to a height of 2230 feet and is well separated from the main Helvellyn Range by a considerable hollow in which lies the reservoir fed by Sticks Gill. Along the summit of this fell there is a string of erratic boulders of local origin displaced by ice evidently moving from the direction of White Side on the Helvellyn Range. There is one great cubical block east of the cairn on the summit and about 20 feet below it. Another instance occurs at Gavel Pike, which is the easterly point of St. Sunday. The shoulder leading up from Latterhow in Deepdale by Lord's Seat to Gavel Pike is extremely interesting. The whole shoulder from 1500 feet to 2100 feet has many erratics on it. As the rock *in situ* is largely andesite and the erratics are a fine grey-blue tuff, and as the latter rock is found *in situ* to the west of this shoulder it is obvious that a strong flow of ice from the direction of Fairfield has passed obliquely across the Deepdale valley. Another stream of erratics, previously noticed by Clifton Ward, lies on Birks, the north-east continuation of St. Sunday, and this stream occurs between 2000 feet and 1750 feet, and lies in a direction roughly north-east and about parallel to that shown by the above-mentioned erratics of blue tuff.

Another very noticeable group of erratics (also mentioned by Clifton Ward) lies on Dowthwaitehead Moss at an altitude of 1860 feet, just west of the point where Aira Beck makes its turn to the east for Dowthwaitehead. These were probably deposited by ice coming straight from upper Deepdale and passing irrespective of the valley below it in the direction of Troutbeck towards the north-north-east.

4. In the middle reach of the Ullswater valley there are many cases of a deposit of frontal stuff which may give the key to the course of events in this part of the valley. The three best examples are in Glencoyne Park, Swinburn's Park, and between the two hills Birks and Knotts. In the last case we have the only noticeable exposure, and it has been formed on a narrow front by a lobe of ice which has come down towards the valley and between these two hills.

The line of frontal stuff in Swinburn's Park is the best to study because there is a long continuous run of it. It consists of a bank of slightly hummocky moraine matter running along the fell side, its top flush with the ground above it and presenting a steepish drop of a few feet towards the downhill side. For the most part it is inconspicuous, but in a few places it develops into a noticeable feature of 15 or 20 feet in height. This particular run of it begins east of Gowbarrow Fell at 590 feet, and goes along the fell foot towards the north-east at the following heights: 750—800—810, here it forks, the lower and older branch running through 890 to 895, the higher and later branch running

through 990 to 1110, where it dies out on the northern rim of this piece of land.

This is clearly a line of matter dependent on fell formation and not connected with the margin of the valley ice. There are many other places where the frontal stuff can be found. Sometimes it takes the shape of low moundy rolls of drift with a lobate front and almost simulating the appearance of a very irregular delta. It generally occurs somewhere about the height of 660 feet or upwards. It is continued no farther up the Ullswater valley than Glencoin. As there are reasons for thinking that valley ice stood about 600 feet O.D., and as the line of frontal matter ceases at about this height, it suggests that along the middle reach at one stage of the retreat there was valley ice, and at the same time fell ice on the slopes above with a gap between the two. And further that in the more southerly part of the valley beyond Glencoyne no such separation occurred in such a noticeable way.

In any case these facts show that an orderly retreat of the ice front did not take place inside the fells but that the Highland Glaciation was continued on to dwindling stages in which a thin sheet of ice clung to the fells depending entirely on immediately local conditions.

5. The evidence for the conclusion that the first parts to be cleared of ice in the middle reach of the valley were the lower slopes lying between 600 feet and 900 feet has been touched upon in the preceding paragraphs. It consists in the existence of frontal stuff, which is evidently a deposit of some fell ice clinging to the slopes of the fell above at the same time that the bottom of the valley was still occupied by ice of the main Ullswater glacier. Further evidence of this state of affairs is found in the presence of clays marking the site of temporary marginal lakelets. In one place in Glencoyne Park this site exactly tallies with the above description. It has frontal stuff on the upper or fell side, and its lower or valley side corresponds with the estimated position of the main valley ice-margin.

6. Mention has already been made of the esker-like gravelly deposits near Castlehows Point on the west side and at Hodgson Hill on the east side of the lowest reach of the valley. Both of these detached mounds are possibly 15 to 20 feet high and appear, from the outcast of rabbit burrows, to be of gravelly material. They lie not immediately in the present path of becks but quite close, and they are probably the infillings of crevasses or stream beds in stagnant ice.

On the east side of this lower reach there is at least one considerable kettle-hole and, generally speaking, many of the lower slopes have the moulded appearance of a huge cavity in which ice has melted *in situ*.

Having dealt thus with our six conclusions we may turn to particular forms: Ridges, Combes, Lake Sites, Deltaic Moraine, Asymmetric Combes, Kirkstone Top, Drumlins, Contours, Drift, etc.

The Ridges.—In this district, but slightly tampered with by the hand of man, it is possible to see the landscape as it has been fashioned by the forces of nature. Nowhere is this more the case than on the great ridges and in the great combes which lie on the east side of the Helvellyn range. These ridges often

consist of naked rock with steeply sloping sides and, like the terminal combes or corries, their final shaping belongs to a late period of the glaciation.

Swirrel Edge lies between Brown Cove on the north and Red Tarn on the south. Its slopes on both sides and the end slope of Brown Cove are generally climbable by the ordinary scrambler and cannot have a gradient exceeding 30 to 40 degrees. Of a similar nature is Striding Edge, between Red Tarn and Nethermost Cove. Cofa Pike, on the ridge between Fairfield and St. Sunday, has the same erosional character. All these ridges have a feature which seems to be glacial in its origin. The subsidiary ridge shows a very distinct dip before joining the main mountain range. Thus Swirrel Edge dips down between Helvellyn and Catstye Cam; Striding Edge has an equally noticeable fall between Helvellyn and its own main part at High Spying How. The same feature occurs on the east side of our district, where Beda Head is slightly detached from the main part of Beda Fell and the Nab similarly isolated from Rest Dod. Perhaps a more striking case is the similar configuration in Rough Crag, between Blea Water and Riggindale, although this lies outside our area. This structure can hardly be the result of any glaciation at or near the maximum, but must have arisen at a late period when the ice was still vigorously active in the great end combes. At that time the encroachment from both sides by these end combe glaciers would lower the crest of the ridge and cause these noticeable dips.

The Combes.—Several of the great combes or coves might furnish material for a whole section, so diverse are the characters of these huge hollows. Approaching Helvellyn from the north, Keppel Cove is the first in which the general combe features are well developed. It faces south-east, has excellent striations on andesite pointing straight out of the cove, and it has one of the finest semi-circular terminal moraines in the district.

Brown Cove faces north-east, but despite this advantage and its greater cubic content it had evidently lost its push and was unable to prevent the deposition of the Keppel Cove moraine just referred to. The centre of the cove is occupied by a large grassy delta formed in a tarn now nearly filled up. This green space gives the cove a particular charm. Red Tarn Combe is perhaps the most striking of all. It faces rather north of east, and the last stronghold of the ice seems to have been not directly on the main slope of Helvellyn but at the angle where Striding Edge articulates with Helvellyn. Around the shores of the tarn there is a series of well-glaciated rocks, and the path up to Swirrel Edge goes along a marginal moraine for part of its way.

Nethermost Cove, on the south side of Striding Edge, faces south-east, and has a huge boss of glaciated rock in the middle. This island of rock is rounded and glaciated on the lee side as thoroughly as on the stoss or impact side. Harker, in his paper on "Ice Erosion in the Cuillin Hills, Skye," remarks on the occurrence of such rocks in the inner parts of the mountain area and suggests that the explanation may be that the "fracture of rocks (such as is usual on the lee side of roches moutonnées) is not so readily effected under a great pressure of ice." But unless there was a great depth of ice on the very highest parts of these Lake Mountains, the depth of ice must have been much greater in the main valleys than it was in Nethermost Cove. It seems more likely that the explanation lies in the nature of the jointing of the rock. In this case the rock

Caudale Beck Combe, showing terminal moraine and marginal line outlined by snow

Rattlebeck deltaic moraine, showing (1) upper part, ordinary boulder clay in two divisions, (2) lower part, deltaic moraine partly obscured by tree shadows

Frontal stuff at foot of Birks near Skelly Neb

Glenridding Beck 1500 feet above O.D.: great blocks, almost in situ, lying in boulder clay

is a very coarse massive tuff with joints very few and far between, and that is often the character of these huge glaciated bosses of rock which have successfully resisted glacial destruction. Harker himself points out that his suggestion is only one of the factors to be considered and mentions also the nature and jointing of the rock. The other combes must be omitted.

Lake Sites.—One of the most interesting examples of fossil scenery in our area is the occurrence in many places of old lake sites. Nearly every valley in this area has had at one time or another, during the retreat of the ice towards the upper combes, one or more lakes which have since become filled up. Most of these old lakes or tarns were held up by accumulations of drift.

Fusedale had a lake at the lower end dammed up by a boulder-clay mound at the mouth of the valley. This lake stood at the level of 615 feet, and a section in what was once its west shore shows bedded gravel, and at one time a big boulder, as if dropped by floating ice, was to be seen surrounded by this gravel. Bannerdale, Boardale, Caudale Head, the upper part of Hayeswater Beck, and Pencil Mill Beck all have such lake sites. Cumberland Deepdale has two old lakes, one at 1220 feet below Dowthwaitehead and one at 1690 feet below Randerside Fold in one of the boggiest parts of the district. Patterdale Deepdale has been the scene of the most orderly and orthodox recession of the valley glacier. It has left a most interesting series of terminal and marginal moraines which held up three or four lakes.

These lakes have all been filled up, but there is evidence of another type which has been drained off. In Glenridding valley at Tenterhow there is a good example at 580 feet above O.D. of a delta which has been formed in water standing at that height and which has been preserved owing to the fact that the beck has moved away to the right. On the opposite side of the beck at the same height there is a layer of sand and gravel 1 foot thick which was revealed lately in making a cutting for a water-pipe. As there is no evidence of sufficient import to prove that water stood at this height in the main valley, this delta is interpreted as the proof of a short lake held up at the bottom of the Glenridding valley by ice in the Ullswater valley. Hartsop valley may have had a similar small lake. The configuration of the ground suggests it, and there is a truncated esker-like promontory of boulder clay with some current-bedding as well as a deposit of gravel, both at 600 feet.

Another type is shown in the case of two tarns situated on the very top of Red Screes at a height of 2530 feet. They have no name, but are big enough to be marked on the 6-inch map. The easterly one appears to be a little rock basin. There are several erratics in the close neighbourhood.

Another extraordinary site is the old peat-filled tarn which occupies part of the depression between the two Angletarn Pikes at an elevation of 1840 feet. A third instance occurs at a slightly lower altitude on the summit of Beda Fell. All these latter tarns seem to be due to glacial erosion.

Deltaic moraine.—Perhaps this is the best place to mention a remarkable section at Rattlebeck, just a short distance above Glenridding village. It is exposed in a perpendicular section on the left bank of the stream at the height of 600 feet O.D. The upper half of the section consists of stone-coloured unweathered boulder clay of moderately tough texture. The lower half consists of roughly stratified materials in which there has been no sorting under

the action of water. This lower part of the section is easily susceptible to attack by the water. When it is cut away the upper part falls in after a certain amount of overhang, and thus a fresh surface has been presented for many years now in which the details differ but in which the same general structure has been visible throughout. The bedding in the lower part is inclined at 10–25 degrees downstream and is not the same throughout the section. At the same time this bedding is much too regular to be explained by the tilting through ice action of originally horizontal layers of gravel. Furthermore, the absence of clay from the deposit shows that it was laid down under water. In May 1931 Dr. Paul Beck showed me some of the most striking glacial phenomena near Thun, in Switzerland, and amongst them was an example of what the Swiss call "Moraine en Delta." This deposit was exactly of the nature described above but on a much larger scale, and it is interpreted as being debris brought forward by the ice and fed direct into standing water. If similar deposits are found elsewhere and it becomes necessary to name them, the phrase "Deltaic Moraine" might be used. Up to this point the larger features only have been dealt with, but there still remain several smaller points which it is hoped will not be devoid of interest. The difficulty is to keep the wealth of matter within reasonable bounds.

Asymmetric combes.—Caudale Beck Combe, heading back into the mass of John Bell's Banner, is a most interesting workshop of nature. It faces north-north-west, and the top of its end wall reaches over 2400 feet. The western boundary is more precipitous than the eastern, due to its better aspect for the duration of the dwindling glacier. Two streams have been developed, one at the foot of each bounding slope, and the original glacier floor has been left between them practically untouched. This is usually impossible in these valleys owing to the development of the stream in the middle of the valley. In this case it is seen that the two becks have eroded 50 feet of drift in the deeper parts of their beds.

Another asymmetric combe exists at the head of Rams Gill, where the High Street range has proved the more generous source of ice. The valley head has been split into two parts by a projecting buttress of rock, as in Ruthwaite Cove, with the consequent development at a later stage of two separate glaciers. There is a fine moraine apparently medial on the left bank of the beck and running down from 1730 feet to 1230 feet, where the stream has broken through it. How far this moraine is a genuine medial moraine and how far it is a frontal moraine for a lingering mass of ice clinging to the higher cliffs of the east side, it is difficult to say.

Kirkstone Top.—Kirkstone Top, at the height of 1484 feet, forms the watershed between Kirkstone Beck and Stock Gill. It is liberally covered with moraine mounds of the hummocky type. They show no stoss and lee-side differentiation of slope. The rock surfaces on the slopes of Red Screes seem smoothed as if by ice moving from the north. The position of perched blocks on these heavily glaciated rocks also corresponds with such a movement. A trail of erratics showing well-marked bedding descends in the Windermere direction. This rock is *in situ* at the top of the pass at the foot of Red Screes. A similar movement from north to south may be indicated by erratics with quartz across the col between St. Raven's Edge and John Bell's Banner.

It is possible that the Lakeland ice, hampered in free movement to the north by Scotch ice and having a free exit to the south, had its ice-shed somewhat to the north of the present watershed of the area.

Drumlins.—On the east side of the lowest reach there are drumlins lying between Thornthwaite Neb and Pooley Bridge, and here we have also an example of a half-drumlin. The drumlinized tract on the west side is of larger extent and lies between Skelly Neb and Wreay. A hill south-west of Watermillock House has all the appearance of a drumlin, but as it has solid Skiddaw Slate at the surface to the south of it, it may only be a case of drumlinized rock with a veneer of drift. The main axis of all these drumlins corresponds with the direction of this reach of the valley, and they were probably formed well after the maximum.

Contours.—The main valleys are in many cases long troughs with a comparatively small gradient and a cross-section which generally keeps constant but which actually in some cases shows a narrowing towards its lower end. This narrowing, which is contrary to the tendency of sub-aerial erosion, is shown by certain contours in Patterdale, Bannerdale, Hayeswater, Grisedale, and Boardale. The result is probably due to the erosional action of the ice continued in the upper part of the valley long after it had ceased in the lower part.

Structure and pitching.—In the 'Handbook of Geology of Great Britain,' Dr. Slater has called attention to the fact that "Structure" can be seen in boulder clay. This appearance is occasionally visible in the lower boulder clay of these valleys and is to be seen in Fusedale, Ramsgill Beck, and elsewhere. The sections make it look as if pressure from above and behind had made the upper layer slide bodily forward down the valley. In one case in the upper clay it appeared as if a vertical cleft like a gaping fault had been developed which had subsequently been filled with loose matter.

The stones and boulders in a stream have a well-known manner of pitching in accordance with the direction of the stream. The actual result is best shown by a diagram where the arrow shows the direction of movement of the stream. In several cases there has been a resemblance to this arrangement in the boulder clay. The cases are analogous in so far as each consists of a moving medium with heavy carried materials passing over a stationary ground. It has only been seen in close proximity to the solid rock.

Screes and great taluses.—Ordinary sub-aerial screes occur at the foot of most exposures of rock, but they are generally of limited extent. Some observers have commented on the small amount of sub-aerial waste to be found among the fells. Others have pointed to great accumulations in certain places. Both kinds of statement are misleading unless it is pointed out that the rocks vary in the most extraordinary way in their capacity for forming screes. Some of them, especially some andesites, are so riddled with weathering joints that they tumble to pieces with a gentle tap. Others, noticeably coarse-grained tuffs, are so massive and compact that they seem almost impervious to the attack of the weather. One of the most interesting points is the relation of the real scree to those great taluses which are found in some places. Dr. Harker,

referring to these collections of huge angular boulders, says, "It is often impossible to divide these accumulations from the similar material farther downstream which has undoubtedly been ice-borne probably on the tail of a dwindling glacier." The great taluses in some places, such as below Yew Crag (Gowbarrow), Yak Howe (Glencoyne), and possibly Raven Crag in Threshwaite Mouth, are due to ordinary sub-aerial waste. In these places they occur because the jointing of the rock is so situated as to help the slow forces of the frost in loosening and discharging these big boulders. But there are other places like the slopes of Swarth Fell and the combe above Hard Tarn, where local cliff ice or a combe glacier is responsible for having brought down local short-distance erratics.

Striations.—Dr. Mill, in his "Bathymetrical Survey of the English Lakes" (*Geographical Journal* for August 1902), has pointed out that the islands of Ullswater are smoothed and striated, and that the striations are better preserved below water than when exposed to the air. One frequently finds striations half hidden by stiff boulder clay and evidently recently revealed by the clearing away of some of this superincumbent material. No striation can be accepted as a true indication of the direction of ice-movement unless the place of the scratch is nearly a plane surface. On a bulging surface the direction of the scratch has to accommodate itself to the surface.

Little need be said about the great number of striations that are to be found except to point out that their number would have been infinitely greater had the rock been less refractory. There is no striated rock in the valley that can show such well-incised lines as those seen on some of the Skiddaw Slate rocks at Grange, in Borrowdale. Very many of the coarse roches moutonnées have not a single recognizable striation on them. One or two striations have however a special interest. Immediately above Hard Tarn there is a flat ledge of rock, and under a huge erratic perched on this ledge there are some excellent striations pointing out of the cove. Near Crookabeck Farm striations occur in the bed of the Goldrill Beck about 1 foot below the usual water-level. This has a close bearing upon the amount of alteration that has taken place in post-glacial times in this particular spot. Lastly, some occur at an elevation of 1800 feet on the ridge bounding the Glenridding valley on the north. These lie on the crest of the ridge and point along the ridge and straight out from the nearest high land on the Helvellyn watershed. They do not swerve down the slope to the Glenridding valley or into the adjacent valley on the north, and must belong to a time when the ice there paid no heed whatever to the immediately local configuration but belonged to a mass governed by wider general features.

Marginal lines.—Other fascinating relics are the high-level marginal lines, which reveal the old location of the edge of a stream of ice. One such is seen in certain lights or when the ground is covered with snow on the west slope of Birkhouse Moor. It runs from 1700 feet to over 2000 feet and marks the edge at a certain time of Red Tarn Glacier, but when searched for on the spot nothing can be found of any tangible shape.

Depth and erosion of the drift.—The gravelly mountain drift is never thick, and probably 6 feet would be an exceptional measurement. It has been seen of this thickness in the Watson's Dod section at the head of Browndale

Beck, under the peat south of Wether Hill and in the upper rim of Keppel Cove.

The looser moraine matter spread out in the combes may be up to 50 feet deep but is usually about 25 feet. Where the matter stands up as definite moraine, either of the terminal or lateral kind, the height may reach 40 or 50 feet. As striking examples of these moraines those in Pasture Beck, in the upper Hayeswater valley, in Rams Gill, Grisedale and Deepdale (Westmorland) may be cited.

The gravel and clay between two boulder clays is generally quite thin, 3 feet being a common measurement, but the deltaic moraine under an upper boulder clay at Rattlebeck is 12 feet thick. The dense lower boulder clay is not usually thick as far as can be judged, and 10 feet would be a noticeable measurement. The depth of the drift where Park House Gill cuts through a half-drumlin is 35 feet, but it is impossible to see what sort of drift this is.

All the considerable becks have been filled with boulder clay. Although all have cut down to live rock in the steeper places, there remains a great deal of boulder clay on the banks. In Aik Beck, for instance, there is about 40 feet of stiff boulder clay in the bank at 730 O.D.

It is generally held that the surface of glacierized country in the north of England is pretty much as the retreating ice left it and has not been much modified subsequently by sub-aerial or water erosion. This is not true for the upper parts of the valleys or for the combes. In these steep places the retreating ice at certain times of the year would pour great masses of water on the lately deposited drift. When the steep gradients of the valley walls and the huge snowfall and rainfall at that time are remembered, it is no wonder that abundant evidence of considerable erosion can be found. Sometimes small systems of drainage have been developed amongst the mounds. In places one may see a collection of bigger boulders lining a gap in a moraine ridge, showing that the latter has been breached by running water which has left these blocks behind.

Where Nethermost Beck joins Grisedale there is a fine series of lateral moraines in which the intermediate valleys have been deepened by streams which have here and there cut through the ridges, thus following the line of steepest slope and so breaking up the orderly array of ridges into a disorderly patchwork of more or less isolated mounds, plateaux, and ridges. There is a curious group in Dovedale where Hogget Gill joins Hartsop Beck. Another noticeable group occurs where Caiston Glen joins the Kirkstone valley. It would be tedious to enumerate cases where subsequent erosion has intensified the slopes of the mounds. In Pasture Beck, north of Raven Crag, there are great plateaux of moraine, and in one place a middle channel has been cleared out measuring 30 feet deep by 40 yards wide. Parts of the upper Hayeswater valley, which is the best place for examining this subject, show that a depth of 20 to 40 feet must have been eroded altogether over some considerable area.

The nature of the glaciation.—Our area, so far as glacial effects are concerned, is divided into three main categories. First there is the rounded summit land where a Highland ice-cap, to use Wright and Priestley's nomenclature, has not destroyed the old contours and has not seriously modified the surface.

Secondly, there are the great hollow and fairly steep-sided valleys where

there has been great thickness of ice and great movement with a resulting great erosion and at the same time a considerable planing effect.

Thirdly, there lies between these two extremes a great deal of rugged land comprising the ridges on the east of the Helvellyn–Fairfield range, the surface of a lot of secondary hills like Sheffield Pike and Place Fell and the country around Angle Tarn.

The erosive power of the ice would vary with some power of the velocity and also with the pressure or depth, and secondly it would depend upon the susceptibility of the rock. The latter would depend far more upon jointing than upon hardness.

In the banks of the Glenridding Beck it is possible to see blocks large and small, of the native rock in the very process of being removed from their position *in situ* to become part of the boulder clay. In fact, it is sometimes impossible to say where solid rock stops and where boulder clay begins. If an outcrop of rock has been subjected to this type of glacial erosion and then cleared from superincumbent matter it presents an absolutely jagged and irregular surface. Such surfaces occur in this beck and are definitely glaciated surfaces, although the latter phrase is usually associated with a ground and polished surface. It may be that it is this kind of glaciation which is mainly responsible for the third great division of our area, namely the intermediate land lying between the rounded lightly glaciated tops and the hollow heavily glaciated valleys.

This variety of surface is very intriguing. One is tempted to suppose that the surface of a glaciated tract may show a response to ice action which depends largely on the structure of the rock. If the latter is continuous and homogeneous and detachable in small particles it may give a more uniform surface. Granite and Skiddaw Slate might be such media. If it is discontinuous and heterogeneous, whether owing to faults, intrusions, deep joints, junctions, changes of chemical character or bands of decomposition, then we may, under the requisite conditions as to depth and movement of ice, get a rugged and irregular result such as characterizes a great percentage of the Borrowdale Rock area.

Before closing this paper I should like to acknowledge my gratitude to Dr. S. E. Hollingworth, with whom I have had excursions on the fells and many valuable discussions. It must not be supposed that Dr. Hollingworth necessarily concurs with all the views here expressed, but it has been a great advantage to me to be able to talk over such problems with him.

MAPPING FROM AIR PHOTOGRAPHS

CAPTAIN D. R. CRONE, R.E., Survey of India

THE excellent paper on the plotting of the vertical photographs of the Everest Flight by Lieut. Salt in the February *Journal* leaves nothing to be added; the subsequent discussion raised two points, one with regard to the use of oblique photographs, and the other concerning the use of ground photogrammetry in air-photo mapping, which were perforce rather summarily dealt with. A certain amount of experience in these two directions has been gained of recent years on the North-West Frontier, so that a summary based on this experience may be of interest.

The Wild photo-theodolite has been extensively used for the provision of points from which maps from vertical air photographs can be scaled and fixed in position. The final plot as it comes from the Autograph represents practically the ideal form of "control" for air-photo maps. The plot shows the conformation of a hill-top or the relative detail round a tree and thus prevents any of the doubt which assails the compiler when faced with a trig. point labelled simple "Peak" or "tallest tree," and a photograph showing two or perhaps even three high points or trees within the circle of probable error. The difficulties of the method are mainly in obtaining the photographic material to provide an accurate plot. In the mountainous country of the Frontier it is not always easy to find pairs of peaks or suitable ridges or spurs having sufficient command and the correct orientation and distance apart to provide suitable camera stations. When they have been found, fixing their geographical position may present difficulties.

A deliberately planned triangulation is the best method of fixing the camera stations, but this is not always possible when paying a flying visit in tribal territory. Trigonometrical interpolation, though very popular, should be treated with suspicion unless it is carried out from well-proved points derived from a single accurate triangulation.

When a site has had to be used which does not altogether fit the ideal conditions for the method or when a slightly doubtful interpolation has been employed to fix the geographical position of one end of the base, the difficulty is to know how far the plot is reliable, in particular in the areas to the flanks or in the distance away from fixed points where inaccuracies in the setting data cause rapidly increasing errors in the plot. On the whole, the photogrammetric method is very suitable, and as the extra photographic equipment is very light, the observer going out to fix "control" for air surveys who takes the photo-theodolite is none the worse off if he cannot find suitable bases for photogrammetry, for the theodolite is a normal one and can be used for fixing triangulated control in the normal way.

Oblique air photographs are employed on the Frontier for mapping areas of which it is not possible or convenient to take vertical photographs. The inability to take vertical photographs may be due to political considerations rendering flying over the area undesirable or to the ground being higher than can be photographed from the flying height for aircraft with photographic equipment, which seldom exceeds 18,000 feet above sea-level. Where possible,

it is arranged that a sufficiently distant horizon shall appear in the background of the photograph and that the photographs be taken in an overlapping series with the camera axes parallel. The method of plotting employed is a graphic reconstruction of the exposure conditions using a horizontal plane determined from the distant horizon. This simple method is described in the *Royal Engineers Journal*, 1933. Three fixed ground points are required at each end of a strip of photographs to scale and fix the plotting.

It is clear that when photographing a mountain massif or range higher than the aircraft there will be no distant horizon to provide a reference plane. The following simple extension of the method mentioned above has been successfully employed in mapping the north-west face of Nanga Parbat from oblique photographs. The oblique photographs are carefully examined and a line is drawn on a photograph in which three fixed points appear. This line is drawn as near as can be judged at the same level as the aircraft. The following points may assist in fixing this line: the altimeter height of the aircraft compared with the heights of the fixed points; the image of any part of the aircraft which appears in the photograph compared with the angle of elevation or depression of the part from the camera position, measured with a clinometer with the aircraft on the ground but in its flying position; the run of the snow-line if it appears in the photograph, and other similar evidence. This line only requires to be correct to two or three degrees; it corresponds to the accuracy with which a plane-table should be levelled for drawing detail in mountains. As before, a graphic rectification of the photograph into this plane is made and the camera station is resected from the three fixed points. The heights of the three fixed points are determined with respect to the approximate horizon and an assumed height of aircraft. A comparison of these heights with the true heights provides three equations from which the three corrections to the approximate horizon plane can be easily obtained. These corrections are to the tilt in the direction of the camera axis, to the tilt at right angles to the camera axis, and to the assumed height of the aircraft. The correct horizon is drawn on the photograph and can be transferred to several successive photographs on each side by comparison of the detail it cuts. This resection in space can be carried out in a matter of two hours for one photograph and checks quite reasonably, so that it provides an excellent method of dealing with oblique air photographs for topographical mapping.

There seems little reason why quite a number of the oblique photographs of the Everest Flight should not be plotted by this method immediately to provide a map of a much more extensive area than that covered by the vertical photographs.

ADMIRAL BYRD'S ANTARCTIC EXPEDITION

It appears that none of the British papers receive the news service of the Byrd Expedition, and this makes it the more desirable that the Journal should publish an occasional summary of events. At the request of the Editor, Mr. J. M. Scott has put together the following, partly from the files of the New York Times and partly from what is described by its publisher, Mr. Horowitz, as a "private and amateur monthly newspaper recording the progress of both the Byrd and the Ellsworth Antarctic Expeditions, although not officially representing either group." The Little America Times is published from 2 Park Avenue, New York, N.Y. It is circulated among friends and relatives of members of the Expedition, and Mr. Horowitz kindly sends us the numbers as they appear. The file is preserved in the Library of the Society.—Ed. G.J.

IN recent years there has been a tendency among polar travellers to reduce the size and expense of their expeditions to a minimum consistent with efficiency. Admiral Byrd has kept himself remarkably free from such restriction. His first Antarctic expedition of 1929–30 consisted of a land party of forty men, and is said to have cost about a million dollars. This year he has fifty-five men at Little America, his old base in the south-east corner of the Ross Sea.

He has two ships. The *Jacob Rupert*, a steel vessel, sailed from Boston on 11 October 1933 with the main party on board. She visited Wellington, New Zealand, in the beginning of December and anchored in the Bay of Whales on 17 January 1934. Her course near the Antarctic Circle had taken her eastward beyond the meridian 120° west in the hope of discovering new land in that unknown sector. With this object Admiral Byrd made three flights from the ship in the Curtis Condor; but no land was seen. The *Jacob Rupert* was turned back by heavy pack and entered the Ross Sea about long. 160° W. The second ship is an old wooden coastguard revenue cutter, *Bear of Oakland*, slower but more hardy to resist the ice. After one false start, when she got into trouble off the Flying Pan Shoals and had to put back for repairs, she got away from Norfolk, Virginia, on 1 November 1933, and came *via* the Panama Canal and Tahiti to the Bay of Whales. Meanwhile the *Jacob Rupert* had been unloading as fast as possible, for Admiral Byrd had stated that February 10 was the latest safe date for her departure. The task was hindered by the calving of the Barrier edge to which the ship was moored. She had to cruise about and come alongside the ice face where she could; but nothing is reported lost except twenty bales of hay. The few miles of barrier ice between the ship and Little America were found to have been contorted by pressure, and the problem of transporting 450 tons of stores seemed enormous till a comparatively direct route was found. At the other end of this journey it was encouraging to find the village of Little America so excellently preserved that the electric light went on at a turn of the switch and the telephone system was still in order.

The *Jacob Rupert* left on February 5, with the expedition's doctor, who had to return on grounds of health. The prospect of shepherding so large a party through the winter without medical aid caused considerable dismay, and

Admiral Byrd broadcast an appeal for help in getting another doctor to the Antarctic before the sea was closed by ice. This request was answered when the R.R.S. *Discovery II* sailed from New Zealand, met the *Bear of Oakland* at sea, and transferred to her Dr. Potaka, a young New Zealander, with 15 tons of stores which were also most urgently needed. The passage to Little America was safely made, and the *Bear* penetrated into the Pacific Quadrant 60 miles farther east than Captain Scott's *Discovery* had gone. She finally sailed north on February 26.

Apart from the re-establishment of Little America the autumn land work of the expedition has been almost entirely concerned with making an advanced weather station. Admiral Byrd, it seems, began planning this station a year before the expedition was organized. He hoped at first to build it on the polar plateau. Then, in a message dated February 3, he announced that a wireless licence had been granted "to KFY, 200-watt unit to be set up in the Queen Maud Mountains, 400 miles from the south pole, where two men will live during the polar night to make weather observations." These plans were considerably modified both in regard to the position of the station and its personnel.

Active preparations began as soon as the *Bear of Oakland* had sailed. On March 1 five dog teams started southward with a load of 4000 lb., and four days later the tractors followed and caught them up with a still greater load. Apparently the travelling had proved more difficult than was expected, for the hut was built only 123 miles from Little America. The Fokker aeroplane, which was to have supported the teams, crashed during a trial flight, but on March 17 the Pilgrim monoplane flew to this station with a load of stores and seal meat for the dogs. She made a forced landing on her return flight: Admiral Byrd located her with the autogyro and she was relieved by dog teams. At the end of March Admiral Byrd flew in to direct the seven men who were erecting the hut, and when they started in the tractors for Little America he was left entirely alone. That was the most drastic change from the originally stated plans.

It would be interesting to learn the reasons which prompted Admiral Byrd to undertake a solitary vigil of seven or eight months' duration; but for the present this appears impossible, and we must be content with statements which do not fully explain this point. We read, for instance, that it was his idea "to bury himself out on the Ross ice barrier at 60 degrees and more below Zero to study alone meteorological conditions." The hypothesis that there was insufficient food for two men at the station is surely disposed of when one considers that a man can hardly eat more than 550 lb. of concentrated food in eight months. The dog teams, tractors, and aeroplanes must have started from Little America with over 10,000 lb. of stores; and so, allowing for consumption *en route*, the making of depots, the weight of boxes and equipment and of the hut itself, there should remain a considerable margin of consumable stores. Besides, the aeroplanes could no doubt in emergency have made several more journeys during March. The only light on the question comes from two messages printed by the *New York Times*. The first is from Admiral Byrd himself just before he flew from Little America. "I am doing it," he said, "because I want to do it and am making no sacrifice of any kind whatever." The second was sent by the expedition just after Admiral Byrd had

been isolated and almost suggests that even the party at Little America were doubtful of their leader's motive. "It will be a continuous struggle for existence and an unrelaxing vigilance against fire, cold, and illness. Very likely this is what has prompted Admiral Byrd to take this step. The scientific considerations, which are important, are secondary."

From the scientific point of view it is unfortunate that the station was not advanced farther south, but still it is certain that observations, meteorological and otherwise, which may be made there will be extremely interesting. It is clear that Admiral Byrd feels this with peculiar force since he has chosen to do the work himself rather than delegate it to one or more of the other fifty-five members of the expedition who are now under the command of the chief scientist, Dr. Poulter.

Admiral Byrd has since belittled the dangers of loneliness and commended the peacefulness of the polar night. He is well content, and his scientists may envy him the opportunity for abstraction. Little America is equipped among other things with "electric light and power, a radio broadcasting and communications plant, tractors, aeroplanes, dog teams, repair shops, a maternity ward for dogs and an emergency hospital and medical office, a meteorological station, a library and science hall, a dairy consisting of three cows and a young bull, microscopes and lathes, a mess hall seating twenty-eight men which can be converted into a motion-picture theatre seating the whole camp, a wind-driven electric generator, two manx kittens, and a United States Post Office."

The maintenance of this village alone will keep the party engaged throughout the winter, and Admiral Byrd has sent orders that all preparations are to be made for the spring journeys, and that the two aeroplanes abandoned after the first expedition are to be dug out and overhauled. If these can be put in working order the party will be equipped next summer with four aeroplanes and an autogyro. With these and four motor tractors, numerous sledge dogs and ample personnel the expedition should accomplish much useful work.

J. M. S.

THE JOHN MURRAY EXPEDITION TO THE INDIAN OCEAN: *Further Abstract from the Reports of Colonel R. Seymour Sewell, SC.D., Leader of the Expedition, communicated by Professor J. Stanley Gardiner, Secretary*

THE John Murray Expedition under Colonel Sewell, which left Alexandria on September 3 on the trawler *Mabahiss*, has now completed its work in the Indian Ocean, and the scientific staff have returned to England to work out their collections and to consider the meaning of the observations they have made, the two Egyptian scientists, Dr. Faouzi and Abdu Mahomet, alone remaining in Egypt. They had been away for thirty-eight weeks, of which about twenty-seven had been spent at sea, sounding, working hydrographic stations, and trawling and dredging so as to secure the bottom fauna, the zonal distribution in depth of this being a feature of the work of the expedition.

The early part of the work was described in the *Journal* for February 1934. It covered the area north of the Socotra–Bombay line, while subsequent cruises were directed to mapping the topography of the southern part of the Arabian Sea and to the determination of the water circulation at various depths. The first of these cruises was a direct traverse from Bombay to Mombasa. In this southern part the weather was almost continuously bad for the whole month which had been allowed for the special biological and other work of the Zanzibar region. A traverse was then made *via* Seychelles to Ceylon, hydrographical stations being run at regular intervals and the echo-sounder being continuously in operation.

The next cruise was from Ceylon to the Chagos, between which and the Maldives a depth of over 2000 fathoms was found. For this cruise the *Mabahiss* had been joined by Major Glennie of the Indian Survey, who established pendulum stations on Addu, Kolumadulu, Minikoi, and a series on a line across Ihavandifulu and North Mahlosmadulu; Lieut.-Commander Farquharson, R.N., carried out magnetic observations at the same stations. A series of dredgings and trawlings were put down in the Kardiva Channel, where an atoll-shaped reef was discovered, nearly midway between Toddu and Goidu, with a depth of about 125 fathoms within a rim about 20 fathoms less. After a visit to Ceylon, this bank was further examined, and then a course was set towards Socotra, between which and Guardafui the previous hydrographic stations were worked. After coaling at Aden, the former Gulf stations were also repeated as well as those in the Straits of Bab-el-Mandeb, before returning to Alexandria.

Lieut.-Commander Farquharson successfully managed to keep the echo-sounder running almost continuously over 22,000 miles; he had to act as his own mechanic, the difficulties being very great on such a tiny vessel. Besides the submarine mountains in the northern part of the Bay of Bengal, these soundings have revealed a series of ridges on the ocean floor between India and South Africa. The chief and highest runs from the Chagos towards Socotra, and its direction at once suggests a certain analogy with the central ridge of the Atlantic. It was found in each traverse of this region, and in the

most northern Colonel Sewell altered the ship's course so as to follow in its general direction for 230 miles towards Socotra, from which it proved to be separated by a stretch of the usual bottom flat at 2500 fathoms. The smallest depth obtained on this ridge was 900 fathoms on the southern traverse from Seychelles with a general depth of about 2600 fathoms on either side. The ridge proved everywhere to be double, its two sides at about 1200 and 1300 fathoms with a gully of varying width between, generally over 1800 fathoms in depth. A trawling was carried out upon it, and a number of rock fragments secured; these proved to be a dolerite, a rock of the basaltic series frequently found associated with the Deccan Trap in India. On either side of this Chagos–Socotra ridge the soundings in the three traverses were irregular and may indicate at least two or three parallel ridges of lower height on either side, these, if confirmed, increasing the parallelism to the South Atlantic, the topographical conditions of which were discovered by the *Meteor*.

In all 128 hydrographic stations were worked, and these were a most important feature of the long traverses. All the water samples were analysed on board by Mr. E. F. Thompson, assisted by Mr. Gilson and Abdu Mahomet, for at least halogen and oxygen contents, temperature and acidity also being recorded. Generally these showed a surface streaming to the south-west under the north-east monsoon, replaced by a counter current at 130 to 140 fathoms. At about 400 fathoms the current is again moving to the west, but seems to be deflected downwards at long. 68° E., most of this descending mass being directed into the basin south-west of the Chagos–Socotra ridge. In each basin there was also detected a deeper mass of water of low salinity and high oxygen content, derived from the great Antarctic bottom drift. The water from the Persian Gulf was found at 110 to 160 fathoms at the head of the Gulf of Oman, but it had sunk to 382 fathoms off Bombay. Possibly a certain drift and upwelling of this is the cause of irregularities in temperature, etc., along the Arabian coast and in the Gulf of Aden. The conditions in May before the onset of the south-west monsoon in the Aden region were of course greatly different from those of the previous September and were about what might have been expected a month later; through the Straits of Bab-el-Mandeb the outflow was exceptionally strong.

A special feature of the Murray Expedition has been the collection for further study of the bottom deposits, about one hundred being obtained. This was peculiarly suitable as any mention of such recalls the pioneer work of Sir John Murray, and bottom samples obtained by surveying vessels are bound to become few on account of the advent of the echo-sounder. Grabs were used extensively, as well as long tubes which give sections of the deposit. One of these, 62 inches long, was a core of a reddish yellow ooze with few Globigerina from 2352 fathoms and was apparently the "red clay" so classified by Sir John Murray, though the depth is much less than recorded elsewhere. Many others together with dredgings were from the neighbourhood of Murray's "mud line," but this is a very varying "line" depending on the depth of sinking of the smaller particles and the outwash from coasts. Some of the rock, sometimes from considerable depths, will have to be scrutinized in respect to its formation *in situ*, while masses of manganese nodules from as deep as 2600 fathoms require explanation.

The biological work cannot be evaluated until the large collections, now awaiting sorting, have been examined. It was the special care of T. T. Macan and Dr. Faouzi, the Director of the Fisheries Department of Egypt. No attempt was made to obtain the fauna from depths less than 50 fathoms, the approximate depth to which corals live, nor from the slopes off coral reefs, since these had been the subject of intensive study by previous expeditions to the Maldives and to the coral islands to the south and by Colonel Sewell himself. Comparisons should be possible between the faunas of Zanzibar, Gulf of Aden, and the Indian coast, which had been collected by the R.I.M.S. *Investigator*, largely under the direction of Colonel Sewell. The absence of bottom life in the Red Sea and in the Gulf of Oman over large areas owing to sulphuretted hydrogen made difficulties, but there seemed to be marked differences in animals between life off Zanzibar and off South Arabia. The whole ocean however seems to be a single geographical region, better defined than any land region, most of the main families of marine life being of great antiquity and of cosmopolitan distribution.

A word in conclusion is necessary in tribute to the officers and crew of H.E.M.S. *Mabahiss*, who in this venture proved worthy sons of the Egypt which is famous for its early contributions to exact science.

THE VALLEYS OF THE ASSASSINS

THE VALLEYS OF THE ASSASSINS, AND OTHER PERSIAN TRAVELS. By FREYA STARK. *London: John Murray* 1934. 9×5½ *inches;* 364 *pages; illustrations and maps.* 12*s* 6*d*

"THE great and almost only comfort about being a woman," says Miss Stark, "is that one can always pretend to be more stupid than one is, and no one is surprised." But there is rather more to it than that, when travel in the Middle East is concerned. Wherever the Islamic social system obtains the mere male is from the outset almost completely debarred from contact, not only with half the population of the country he visits, but even with the other half on the domestic side of its everyday life. Again, even a Lur might not think it quite such a great and glorious thing to shoot in the back at close quarters and loot the unprotected guest, if that guest happened to be a woman. The particular advantage referred to by the author has gained in value since the War and the subsequent extension of the control of central governments to regions formerly ruled by hereditary tribal chiefs. The male European traveller, particularly if he is an official, is at once suspect and is prevented from wandering far off the beaten track. A woman, here as elsewhere, has a better chance of getting her way by adopting the piece of feminine technique in question; but even that will avail little unless she has the knowledge and skill to give the right amount of line to officious Persons in Authority, just as Miss Stark played the policeman on the Harsin–Khurramabad road, who was "anxious *coûte que coûte* to make us do something we had not intended," until she finally landed him. While therefore it is perhaps not unfair in these days to expect a better book of Eastern travel from a woman than from a man, that is not to say that it is enough to be a woman to produce a gem like 'The Valleys of the Assassins.'

The four journeys described, two into Luristan, probably the least known of the provinces of Persia, and two into the mountains south of the Caspian, were made between 1930 and 1932. On each occasion the author chose for her itinerary regions which were still almost complete blanks on the latest maps; using a prismatic compass, aneroid, and Abney level, and by dint of great industry, she has filled in a considerable amount of detail along all the routes she followed; the mountain and village names, together with the tribal locations shown on the admirable maps which illustrate each journey, constitute a valuable addition to our geographical knowledge of these parts of Persia.

For her first excursion into Luristan Miss Stark started from Nihavand and, crossing the Varazan Pass, found herself almost immediately in unexplored country, the summer camping grounds, between Harsin and Alishtar, of the Dilfan and Silsila tribes, many of whom belong to the interesting sect of the Divine Truth, commonly referred to as Ali Ilahi. Here she was beyond the last outpost of the regular Persian police, and, notwithstanding anything that has been said above, running serious risk; to have ventured there at all argues great physical courage; it needed even more, in such circumstances, to rifle a Bronze-Age tomb and bring away a skull in a handkerchief.

The second journey was made in the less turbulent district of Pusht-i-Kuh. Passing the Persian frontier post opposite Badra with a surprising absence of fuss, Miss Stark travelled up the Gawi, crossed the great Kabir Kuh barrier by the Milawur Pass, and descended into the Saimarra Valley. Here she unfortunately delayed a couple of days, waiting for a guide to show her the site of a reputed buried treasure, and gave time for a party of police, sent out by the Persian Governor, to come up and prevent her from crossing the river into Tarhan. Even so she succeeded in inducing her captors to take her back by way of Deh Bala (Husainabad) and Aiwan to Mandali, and thus actually saw more country after her capture than before. In the course of these two journeys she investigated a number of ancient cemeteries, acquired a small collection of Luristan bronzes, and noted much useful information regarding the principal sites where these interesting objects are to be found.

Apart from the matter of blanks on maps Miss Stark was attracted to the Caspian region by a desire to visit the valley of Alamut, the headquarters of that extraordinary branch of the Ismaili sect of the Shi'a, which reduced political murder to a fine art and enriched our vocabulary with the word "assassin" from *hashish*, Indian hemp; for it was with a decoction of this, as Marco Polo recorded, that the Grand Master drugged his neophytes before carrying them into or out of his terrestrial garden of delights, actual experience of which helped them to believe in the celestial paradise to come and so increased their devotion and recklessness. On her second journey in the north Miss Stark completed her study of the sites of some of the principal strongholds of the Assassins, and then pushed farther east towards the Chalus valley, to fix the position of Takht-i-Sulaiman, Solomon's Throne, the second highest peak in Persia.

On this framework of geographical, archaeological, and historical research Miss Stark, who combines acute powers of observation and a delicate sense of humour with the fundamental qualification of a knowledge of the language, religion, and social practice of the country, has constructed a delightful narrative. Few authors have caught so happily the atmosphere of travel in the remoter parts of Persia, whether on the road or in the village, or in the nomad camp. A most interesting and charmingly written book, full of good things.

C. J. EDMONDS

A NEW TREATISE ON GEODESY

TRAITÉ DE GÉODÉSIE. Par le Capitaine P. TARDI. Préface par le Général G. PERRIER, Membre de l'Institut. *Paris: Gauthier-Villars* 1934. Two volumes. 10×6½ *inches; illustrations.* xxx+422 *pages:* 80 *fr;* xii+423–732 *pages:* 70 *fr*

SOME four years ago the question arose of revising and extending Francoeur's 'Géodésie,' of which the first edition appeared in 1835. General Perrier, approached by the publishers, proposed to entrust the task to Captain Tardi, and it was soon decided that nothing short of complete rewriting would meet the case, in view of the great developments in mathematical geodesy and the growth of importance of dynamical and physical geodesy which have occurred during the past century. As examples, the method of base-line measurements has been completely revolutionized, whilst developments in theodolites have been no less notable. Determination of longitude has been profoundly influenced by facilities provided by radio-telegraphy, and at the same time the precision of clocks, essential for this work, has advanced greatly. Again, the measurement of gravity at sea, with precision almost equal to that of the best determinations on land, is now feasible, and a great impetus has been given to this method of determining the figure of the Earth. Geodesy, in the sense which the word is understood in France as also in England, corresponds to what in Germany is designated "die höhere Geodäsie," and does not comprise topography, land survey for revenue and settlement purposes, cartography, navigation, etc. Even so it is a large enough subject, and Captain Tardi's work occupies over 700 pages.

General Perrier, in his preface, cites a number of works on geodesy which have been published since 1869. Many of these are written in languages with which most French (and English) readers are unfamiliar. The need of a modern work in the French tongue was clearly existent; English readers also will certainly welcome Captain Tardi's book. It may be said at once that he has produced a most valuable and comprehensive work. The subject is presented in an orderly sequence, rendering its assimilation as easy as its complexity allows. Very considerable detail is given and all the various processes of geodesy are critically examined.

It must always be a difficult matter to know exactly how much to assume on the part of the readers. Obviously this book, which goes into the utmost refinements of the subject, will have a strong appeal to those serious students who make geodesy a life-study; but it will also be a most excellent reference work for those whom the exigencies of service bring temporarily into geodetic work, for all the processes, observational and other, of geodetic survey are adequately explained. As an example, any one coming to the subject of precise latitude observation will find the information he requires in Chapter XIV, where are discussed and described the methods known as Talcott, Villarceau, circum-meridian, Littrow, Struve (prime vertical). As a reference book, its value is increased by chapters on subjects ancillary to geodesy. Thus Chapter III, after giving various useful formulae, particularly of spherical trigonometry, has an instructive account of the Theory of Errors with special application to indirect and conditioned observations such as arise in geodesy, with a note on the symmetrical solution of multiple linear equations. In Chapter V is a general account of angle-measuring instruments and their components. One finds here some useful practical remarks, *e.g.* (*a*) Focusing by means of parallax is not possible when the eyepiece eye-ring is smaller than the pupil of the eye; (*b*) resolving power of a telescope—a very important quality in a theodolite—is 12″/D, D being the diameter (in cm.) of telescope object-glass; so it is generally useless,

as an example, to have eyepiece magnification greater than 50 if the object-glass is of diameter 10 cm. A few instruments are described, of which that of Chasselon may be mentioned. In this the vertical axis is of maximum diameter possible; before swinging the telescope in azimuth it is slightly lifted by a special device, and when lowered it is held secure by friction, thus avoiding the use of the ordinary and not wholly satisfactory clamping arrangements. Again, in Chapter XII is an account of all the astronomy generally needed for geodesy. This of course could be found elsewhere, but its inclusion is useful for reference, and there is a particularly good account of astronomic refraction. Chapter IX deals with the representation of the ellipsoid on a plane, or what would more colloquially be called "projection." In view of recent developments the student will be glad to have an account of this method: though the opinion of the reviewer has always been that geodetic results are much better kept in terms of geographical co-ordinates.

Turn now to the main subjects of geodesy proper. Chapter I classifies the subject under three main heads: (*a*) mathematical geodesy, mainly triangulation, which occupies fascicule I; (*b*) geodetic positional astronomy; (*c*) dynamic geodesy, mainly gravity, both in fascicule II. It is pointed out that geodesy has both practical and theoretical aims and that many of the latter can be fulfilled with the former with little extra expense. Economy of this latter, in the case of some main triangulation of France, has rendered it inadequate for present-day mapping; and Captain Tardi could no doubt have given many more examples drawn from outside France. It is made clear in this chapter that the geoid is the fact of nature and that the spheroid of reference is a conventional figure—a fact not sufficiently recognized by some geodesists. At p. 666 the author indicates the correction necessary to angles measured in triangulation to reduce them to the reference figure, but dismisses it with the remark that the value of the correction is in general unknown. Seeing that it may amount to 1″ or more (particularly on inclined rays which are specially likely to occur in base-line connection figures) there is inconsistency in ignoring this and still striving for the highest accuracy in measurement of horizontal angles (Chapter VI) and bases. The logic of retaining angles for computation to 0·001 second (centesimal) while neglecting the geoidal correction is not apparent. The remedy is the observation of deviation of the vertical in both components at most if not all geodetic stations of triangulation; such observations need not be of the highest precision, and would serve if good to one or two seconds. It may also be remarked in this connection that the introduction of Laplace azimuth control tends to correct the errors introduced by this omitted correction of angles.

It is impossible to refer to each of the twenty chapters in a review of reasonable length. While all are in general excellent special mention may be made of Chapter IV, which contains a very good account of base-lines and their measurements, including valuable notes on invar. Chapter VI, on refraction, is disappointing, no advance being made from the old-time "coefficient of refraction," and undue insistence being laid on the merits of simultaneous observation of vertical angles at two ends of a ray which is not generally feasible. There is no doubt that refraction varies with altitude as it depends on air density; so that it varies with the elevation of a ray. By the old method any deviation of the vertical is lumped in with the refraction which is thereby falsified. More advanced ways of dealing with refraction have been employed for years in the Indian Survey with satisfactory results. Here again is a further reason for the observation of deviation of the vertical at all stations of triangulation.

Chapter VIII gives a useful account of calculation of geographical co-ordinates; but while a criterion of accuracy of relative positions desired may be

1 cm., an accuracy of 2 in a million in scale cannot be obtained from triangulation, which according to Captain Tardi's very reasonable estimate is liable to error of 1 in 50,000 soon after a base is left behind. Chapter X deals with adjustment, and it is explained that the principal aim is *not* improvement of precision but consistency of results. There is a section (B) dealing with the method of adjustment known as "variation of co-ordinates" which seems a little obscure. Changes of azimuth due to changes in terminal co-ordinates of a ray are derived, but it is not clear how these are employed. In section D expressions for probable accumulated error in azimuth and scale are given, but no way of assessing probable error of position is indicated. The expression "force des figures" is equivalent to the English "strength of figure." Chapter XI, on the computation of secondary triangulation, gives graphic methods analogous to those in general use for theodolite resection. Resection itself does not seem to be mentioned anywhere, though its utility in a survey of deviation of the vertical renders this method worthy of a place in a work on geodesy.

The second volume deals with astronomy of position and dynamic geodesy. Chapters XIII, XIV give very complete accounts of determination of time and longitude, latitude, and azimuth. Observation on Polaris, not at elongation, for geodetic azimuth is not recommended, for, in the reviewer's opinion, inadequate reasons. Now that deviation of the vertical in the prime vertical can best be obtained from longitude observations, the main use of a geodetic azimuth is in forming a Laplace control; and, in view of the unavoidable accumulation of error in azimuth it is of doubtful utility to obtain azimuth with a p.e. less than, say, one-third of a second; which can be done from Polaris at any hour-angle. Can much better be done with a circum-polar at elongation, considering troubles of transit level and pivots? In Chapter XV the author deals with the 60°-prismatic astrolabe, but considers that the outstanding difficulty of personal equation has not been solved, and thinks the most hopeful way is by the introduction of a recording micrometer eyepiece and a sensitive level. He does not mention the new 45° astrolabe.

In Chapter XVI a distinction is drawn between "gravité," signifying the attractive force of the Earth, and "pesanteur," which is resultant of "gravité," and the centrifugal force. The *gal* is defined as the unit in cm./sec.^{2} Expressions for the gravitational and rotational potentials are derived. Mention is made of Stokes's classical paper "On the variation of gravity at the surface of the Earth"; but this is dismissed on the grounds that he neglected the conditions of convergence, which is not strictly true. Stokes's valuable method of expressing departures of the geoid from the concentric approximate spheroid in terms of gravity anomalies is not mentioned, and there is nothing to take its place. Chapter XVII gives the mechanics of the pendulum and discusses precision. It is stated that values of gravity observed at Paris have a range of 40 milligals, which is disconcerting. The new Holweck-Lejay apparatus is described and incidentally is called an instrument of interpolation. The last chapter, XX, is on the rigidity of the Earth, tides in the Earth's crust, and variation of the Pole.

A few minor typographical errors were noticed, the most important being a plus for a minus in the sine formula on p. 47.

A much longer review would be necessary to do the book full justice. It is a mine of information and should be acquired by all persons and institutions seriously concerned with geodesy. It reaches a high standard of clarity and comprehensiveness, and the geodetic world will be indebted to General Perrier for his sound judgment in entrusting the work to so able and well-informed an author as Captain Tardi, and to Captain Tardi for the scholarly manner in which he has accomplished his task.

J. DE GRAAFF HUNTER

REVIEWS

EUROPE

BURY ST. EDMUNDS: its History and Antiquities. By W. S. SPANTON. *Cheltenham: Ed. J. Burrow & Co.* [1933]. 7×5 *inches;* 88 *pages; illustrations and plans.* 1*s*

The official handbooks to municipalities published by Messrs. Burrow are well known. At first glance this guide might be taken for one of those, but on perusal it will be found to be quite a different type of book. It might indeed have been entitled 'The Benedictine Order, with some account of the abbey and town of Bury St. Edmunds.' The remains of the great abbey are practically limited to two gatehouses. Of these the Norman Church Gate has suffered from over-restoration, which has also been at work on the two large Perpendicular churches of St. James (now the cathedral) and St. Mary. Luckily the exquisite fourteenth-century Abbey Gate still stands for our delectation in a judiciously repaired, not a ruthlessly restored condition. The author writes feelingly about the harm done in the town by over-restoring old buildings and erecting sham antiques. The remarkable Norman house called Moyses' Hall has not escaped, externally at least. We should have liked to have a more extended account of other buildings of various dates, as, for example, the noble Cupola House; but the author gives a disproportionate amount of space to the life of St. Benedict and the conduct of his Order, which would have had greater interest here if the abbey remains had been more extensive. J. H. R.

CELTIC EARTHWORKS OF SALISBURY PLAIN: based on Air Photographs. Scale 1 : 25,000. *Southampton: Ordnance Survey. Folded,* 2*s* 3*d; on paper flat,* 1*s* 6*d; mounted and folded,* 3*s; mounted in sections to fold,* 4*s*

On this map Old Sarum and Salisbury occupy the south-west corner, the river Bourne, from Allington to Salisbury, meanders across the centre from north-east to south-west, and the Avon along the west side. Though the lettering owing to the scale is in some cases necessarily very small, it is admirably clear. The contour interval is 5 metres. The Celtic features, marked in red, are linear earthworks (including double banks, bank and ditch, flat ditches), fields and lynchets, tumuli and barrow circles, with distinctive markings for those vouched for by air photography but not tested with spade or probe. The whole of this area save, generally speaking, the valley of the Bourne, the neighbourhood of Old Sarum and Salisbury, and the district south-east of Winterslow, is rich in Celtic remains, the most intensive regions being to the north-west and north-east of this map, and close north-east of Salisbury. This map is the first of a series of six designed to cover the Plain; it is hoped "to publish the remainder at fairly frequent intervals." Enclosures on Cockey Down, on the Postway, and outside the camp of Ogbury on the east are here published for the first time. Field archaeologists have here a wealth of suggestion for their activities. Their results should be communicated to the Ordnance Survey, so that this map may be confirmed or corrected. S. E. W.

THE RISE OF THE CELTS. By the late HENRI HUBERT. (The History of Civilization. Edited by C. K. OGDEN.) *London: Kegan Paul, Trench, Trubner & Co.* 1934. 9½×6 *inches;* xxvi+336 *pages; illustrations and maps.* 16*s*

The problem of the Celts has long been one of the most vexed in the study of mankind, and theories have often been advanced on other than scientific considerations. The late M. Hubert, the author of this detailed work, which en-

deavours to digest what is known and surmised about these elusive peoples, approached his task with much circumspection, though he does not shrink from advancing sweeping suggestions of his own. To review it critically would require the united services of anthropologist, archaeologist, philologist, and classical scholar. Here it is possible only to indicate summarily the trend of his conclusions.

He dismisses curtly any idea that the Celts were a race, though there was an ideal type "to which all strove to approach," and by which their contemporaries recognized them. The Celts, in his view, were all those who spoke Celtic. Originating in the east, of the Indo-European family, they appear, from the evidence of place-names, to have settled for a considerable period in Central Europe, before the Goidels, Italici, and Picts branched off. The height of their development was reached in the La Tène period, characterized by the long sword and the double volute ornament, which persisted as a decorative *motif* throughout Celtic art. M. Hubert places the separation of the Goidels and their settlement in Britain at an early date, contemporary with the arrival of the first Greeks in Greece. These Goidels, and the succeeding wave of Picts, were pastoralists. The third wave, the Britons, arriving at the beginning of the La Tène period, were agriculturalists, as were the last, the raiding Belgae. None of these waves drove out their predecessors entirely, though they modified their civilization to varying degrees. The Goidels in Ireland were, from their geographical position, least affected by subsequent invasions.

A second volume is to deal with the phases of the La Tène culture, the decline of the Celts, and their contribution to civilization. The author values their services highly, for he sees in them the founders of French civilization—largely as interpreters of the Mediterranean culture. G. R. C.

SOWJET-RUSSLAND: eine geopolitische Problemstellung. By OSKAR VON NIEDERMAYER and JURI SEMJONOW. (Schriften zur Geopolitik. Heft 7.) *Berlin-Grunewald: Kurt Vowinckel* 1934. 10×7 *inches;* 152 *pages; maps. M.*4.50

This monograph should be of much interest to students of Russia in the past two centuries and to-day. The authors, a German and a Russian, have produced an objective study of the population of European and Asiatic Russia, its growth, distribution, and occupation, in their bearing upon its position as a great power. The bibliographies to each chapter give many references to further literature in other languages as well as Russian, and there are a number of sketch-maps.

After a concise statement of the salient points of the geographical environment—half the total area is unsuitable for agriculture or cattle-raising—the movement of migrants is analysed in considerable detail. Apart from annual migrants within the settled areas of European Russia, and the movement to the towns, the main theme is the flow of settlers to Siberia, heralded by the Cossacks. At first the number of Siberian settlers was small, the main movement being towards South Russia and the Caucasus. From Poltowa, for example, between 1860 and 1876 89 per cent. of the emigrants went south; but between 1894 and 1900 practically the same percentage (87) went to Siberia. The building of the trans-Siberian railway and the Russo-Japanese war stimulated this movement; not however to the benefit of the Far East. Thus, though over three and a half million emigrants entered Siberia between 1896 and 1909, 95 per cent. settled in the west and in the Altai. This colonization has not been uniformly successful, owing to the unfamiliar environment and the necessity for large capital outlay—so that there has been a certain drift back.

The effects of the war and of internal dissensions are also traced, but here the

treatment is of necessity broader and less fortified by statistics. The subjects of the component nationalities and of new administrative divisions are dealt with at length, particularly in relation to the effort to forge an economic union of the widely dissimilar regions. The present tendency appears to be to subordinate national to economic considerations. The problem here, as it has been throughout Russian history, is that of communications. The railway system, which developed haphazard in the nineteenth century until Witte reorganized it, has been inadequate in relation to the enormous area, and the writers criticize the present régime for neglecting it in favour of the development of heavy industries, especially as internal water transport is said to be deteriorating. The chief railway built in recent years is the Turkistan–Siberia line, but this is said to have done little to stimulate traffic between these regions, or to have encouraged colonization. They also show how the industrial zone is shifting eastwards; recent large-scale developments are mainly concentrated in the Ural–Kuznetz area of western Siberia. Though this is intended to develop the resources of that area, its effect is to remove still further the industrial centres of the Union from the markets of the world. The authors are cautious in expressing an opinion as to the possibility of Russia achieving self-sufficiency, though in one passage they refer to her economic unity as a colossus with feet of clay. G. R. C.

FROM TRACK TO BY-PASS: a History of the English Road. By T. W. WILKINSON. *London: Methuen & Co.* 1934. 7½ × 5 *inches;* xvi + 240 *pages; illustrations.* 10*s* 6*d*

In recent years much literature has naturally been devoted to our roads. This book covers much the same ground as the late Gilbert Sheldon's 'From Trackway to Turnpike' (1928), and 'The Story of the Road,' by J. W. Gregory (1931), though our present author does not deal with roads outside Great Britain. It is a fascinating subject from the historical, economic, and engineering points of view, and this book makes very interesting reading, being close packed with matter well set out. Our highway system is described as "a patchwork, a conglomerate, the supreme product of our general 'muddle-through' policy." Certainly Parliament cuts a very poor figure in the story, but perhaps the strangest thing among many remarkable episodes is the loss of the art of road-making, when all the while remains of Roman roads are there as models. These pages cover a wide field, but perhaps it will not be ungracious to say that a few good points have been missed. The "close association" (p. 19) between Coldharbours and Roman roads is a thing happily now completely disproved in 'Place-Names of Surrey': this snake has long wanted scotching. It is apparently unknown to the author that in Roman times there was such a thing as an iron road, *i.e.* a road for the transport of iron and largely made of iron slag, which connected London with the coast at Seaford, via Edenbridge and Ashdown Forest, as is related by Mr. I. D. Margary in the 'Sussex Archaeological Collection,' 1932 and 1933. We may here plead that all modern roads and bridges should plainly show the dates of their construction. S. E. W.

ARE YOU GOING TO RUSSIA? By LARS MOËN. *London: Chapman and Hall* 1934. 7½ × 5 *inches;* xii + 264 *pages; illustrations and sketch-maps.* 5*s*

To any tourist hesitatingly contemplating a journey to Russia along well-known routes and anxious to discover, before finally deciding for or against, just what conditions will be encountered, this book will be of great assistance. For it is a wonderfully true picture, not of the conditions under which Russians live (which conditions it barely discusses except in connection with advice to prospective workers), but of those encountered by visitors. Yet while claiming to

contain instructions to enable a traveller to see Russia for himself and by himself the author's advice is "in the strongest possible terms not to try doing it on your own." The only alternative being a guide supplied by Intourist, the Russian travel bureau, a somewhat carping criticism might be that the book, in foretelling the arrangements to be made and the information to be given by that guide, might rob the journey of the freshness of what little adventure there may be in visiting a country so different from all others.

But many like to know just what to expect, and here they will find it tinged ever so faintly with optimism. For the reviewer cannot unfortunately wholeheartedly and from experience agree with all the statements. That, for instance, "everything you get in writing will be carried out to the letter," or that trains are "quite clean" and express trains "scrupulously so." Not that there is no warning of the presence of vermin, but it is qualified by the assurance that it is not much worse in Russia than in France!

The most detailed instructions are given as to luggage, what to take (including a mouse trap!), hotels, food, medicines, city transport, shops, currency, and routes to and from Russia, besides innumerable useful Russian phrases with translations. The many pages alone of menu items printed in Russian script with phonetic pronunciation should be of particular assistance when the traveller is faced (as he invariably is) with a menu in Russian. Information is confined for the most part to conditions in the four great cities—Moscow, Leningrad, Kiev, and Odessa, but a sketch of districts farther afield is given in one chapter in which the best-known Intourist routes are briefly described. There is no effort to compete with any existing Russian guide-book, since this book attempts to set forth not so much what to see as how to tackle the preliminaries to sight-seeing; in which it succeeds. E. W. N.

TO THE MEDITERRANEAN IN "CHARMINA." By E. KEBLE CHATTERTON. *London: Rich and Cowan* 1934. 9×5½ *inches;* xii+240 *pages; illustrations and sketch-map.* 12*s* 6*d*

The *Charmina* is a beautiful 6-ton auxiliary yawl, and her owner describes her voyage from the Atlantic coast of Brittany south to the Gironde, and thence by the Canal de la Garonne and the Canal du Midi to Sète on the Gulf of Lyons, with a final coastwise passage to Toulon. The author's main purpose is to provide what the men of old days called a ruttier, a detailed guide to others who may follow the same track, with instruction on the best ways of meeting its difficulties, and warnings of the unexpected dangers that may confront the uninitiated. He has done this with what appears to be perfect competence, although that point can be judged only by those who have covered the ground. But he has done a good deal more. The book is no mere ruttier but also a record of a considerable sporting effort, modestly told, and of a lovable little ship, and not least of a multitude of friendly people with whom the *Charmina's* crew had contact at every stage of their voyage. If all travellers possessed Mr. Chatterton's gift of easy intercourse travel would be a more joyous thing. Among scores of fishermen, business men, officials, and lock-keepers he seems to have met not one "bad man," which indicates that he is a pretty good man himself.

But if this French cruise produced no bad men it did produce some bad places, and the entrance of the Gironde is one of them. The *Charmina* found it an awkward spot, with shifting sands making the chart untrustworthy, and a vicious tide that caused anxiety all the way up to Bordeaux and beyond. Mr. Chatterton mentions the mediaeval wine ships, and it is a marvel how they made that passage, with little manoeuvring power and scant assistance from charts and lights. It was a winter trade, too, for the season's wines came to market late

in the year and were exported without delay. There were other awkward places also, on the Mediterranean coast, and even in a *mistral* at the closing stage of the canal journey. When time was up they laid up the boat at Toulon and took passage home in a liner. It was an anti-climax. "This liner life, with its artificialities, its railway-like time-tables, its boisterous young females eternally playing idiotic deck games, was the most boring of experiences. . . . This so-called pleasure cruising may be all right for some people, though not for us, who preferred uncertainty, independence, and adventure." J. A. W.

ASIA

SCRAMBLES IN JAPAN AND FORMOSA. By the Rev. W. H. MURRAY WALTON. *London: Edward Arnold & Co.* 1934. 9×5½ *inches;* 304 *pages; illustrations and maps.* 18*s*

The growth of mountaineering in Japan during the past two decades is but one more instance of that eclectic and versatile spirit which is one of the characteristics of the Japanese people; formerly considered as a form of religious observance and limited in its scope, it has now become a national recreation, and in this book we read of mountains and passes that were formerly known only to a few being now regularly climbed and traversed. Furthermore the sport that is growing thus rapidly in Japan has already been taken up in Formosa, and Mr. Walton is among the fortunate few, other than Japanese, who have climbed the mountains of that island and seen something of their sombre magnificence. As befits the true mountaineer, Mr. Walton writes in a generous spirit of the work done by others, and neither he nor Mr. Kojima—who contributes the preface to this work—fails to pay tribute to the pioneering work accomplished in this field some twenty or more years ago by Mr. Walter Weston who, like Mr. Walton, was formerly a missionary in Japan. Both those who are interested in Japan and those who are interested in mountaineering will read this book with pleasure. Though he writes modestly enough of what he himself accomplished, it is clear that some of the climbs that Mr. Walton undertook called for skill and endurance of no mean order. He combines moreover a love of the mountains with a scholarly knowledge of the language, customs, and mentality of Japan, and his accounts of certain of the more obscure forms of Japanese religious observances are a valuable contribution to knowledge.

It is only in the subjective treatment of his material that Mr. Walton is disappointing. His own impressions are valuable enough, and he need not have decked them out with a host of poetical quotations: the book contains some twenty-five such quotations—largely from Wordsworth—within two hundred and ninety pages. The illustrations are good. E. H. DE B.

AFRICA

THE AFRICAN TO-DAY. By DIEDRICH WESTERMANN. *London: Oxford University Press, for the International Institute of African Languages and Cultures* 1934. 7½×5 *inches;* xvi+344 *pages.* 7*s* 6*d*

The title covers rather a wider scope than does the actual work. The author tells us himself that the subjects discussed have mostly reference to West Africa and that the examples are largely taken from that part of the Continent. It would indeed have been impossible for him to have dealt with the different peoples of Africa on the same scale as he has done with the negroes of the West and at the same time to serve the purpose he sets forth at the end of the first chapter. The reader scarcely needs to have it pointed out to him that much of the book is not

applicable to all the African peoples of to-day and that much is applicable to peoples that are not African but are on the same level of culture as the natives of West Africa. Indeed it will occur to him now and again that in the long-ago history of Great Britain there were phases of culture with attitudes of mind and actual customs not dissimilar from some described by Professor Westermann. There was however this great difference, that external influences introduced changes much more gradually in our case than in that of African development, and so these changes were more deeply impressed and involved less disintegration than those that have come to Africa in the few generations that have passed since European colonization first began.

Apart from what is suggested in the above observations there is little to criticize while there is much to admire in the way Professor Westermann puts before us data on which should be based the solution of the practical problems arising from European penetration into Africa. Chief among such data are the characteristics of the negro's mind, his consequent outlook on the natural and supernatural worlds and his conduct as it arises from that outlook; the ordering of his life in the family, the clan, the village, and the tribe, and of his work in the field and on the prairie; and his mastery of art and of craftsmanship. Other data are the new conditions introduced by European colonization and their natural though not inevitable effects on the native character, mentality, and life. Comparatively recently it has been sought to make use, for the modification of these effects in the interests of both natives and Europeans, of the results of scientific study and of the conscious application of these results to the solution of the problems that have arisen in Africa and threatened the well-being of both races.

In most cases the author, after reviewing the conditions which give rise to these problems, contents himself with setting forth the further investigations which should be made by the International Institute of African Languages and Cultures of which he is the Director before definite solutions can be attempted; a list of these investigations comes at the end of most of the chapters in the book. As regards some of these problems however he gives definite opinions which are always well thought out and singularly free from racial or other bias. These opinions are mainly concerned with government, with missions and education, and with economic activity. As regards the first he is in favour of Indirect Rule, that is, of European official co-operation with the Chief—"an admirable method of attaining the main object of all education, namely, the creation of personalities, conscious of their responsibilities." He lays stress on enlisting the hearty co-operation of the educated natives in making this system effective. In the matter of religion he looks forward to an African form of Christianity as one of the important factors which will contribute towards social reintegration. In the vexed question of bride-price, *i.e.* gifts by the bridegroom to the clan or parents of the bride, he anticipates a freer interpretation of the custom in the future leading to the disappearance of its more obvious abuses. On the still more debated one of polygamy, he makes the guarded statement that "the conception that Christianity and monogamy belong inseparably together is so universal in Christian communities that they would vigorously oppose any relaxation of the marriage bond." Professor Westermann thinks there should be a great number of village schools giving a five-year elementary training such as will suit the needs of a future peasant or craftsman, and some high schools at which it would be possible for the African youth to develop all his capacities. He advocates education in the vernacular so that the pupil should not be dissociated from his own social bonds, but even in the elementary schools the teaching of a European language should not be excluded. In high schools, of which the object is to introduce the student to the best of European civilization, instruction will

necessarily be in part in a European language, but knowledge of the vernacular and of native lore which might enable educated natives to keep in touch with the people must not be neglected. The problems arising from the disintegrating effect of the industrial association with Europeans in mines or on plantations are illustrated by Professor Westermann largely by references to what has happened to the Bantus on the South African goldfields, and here also he has views as to reintegration.

These are only some of the matters dealt with in this excellent book. It is not our plan further to indicate its contents: these are set forth in a full table at its beginning and in the relevant parts of that table repeated at the head of each of its thirteen chapters. The arrangement of the book is on the whole satisfactory. There is no repetition except where it seems to be required to emphasize matters of particular importance. The style is for the most part clear though now and again there is a lapse, *e.g.* in the lower part of p. 5, and in what is said with regard to the bride-price on p. 117. These are but small blemishes. In a preface Lord Lugard cordially recommends the book to all who are interested in Africa. A recommendation from this source scarcely requires endorsement; we would however call attention to it. M. N.

THE ROCK-ENGRAVINGS OF GRIQUALAND WEST AND BECHUanaland, South Africa. By M. WILMAN. *Cambridge: Deighton Bell & Co.* 1933. $12\frac{1}{2} \times 9\frac{1}{2}$ *inches;* xii + 78 *pages* + 70 *plates with text; illustrations and map;* 25*s*

The Rock Paintings, commonly known as Bushman paintings, found throughout the greater part of South Africa, have long been known. A good deal has been written on the subject and several volumes of reproductions of these remarkable drawings have been lately issued. They are found scattered over the greater part of South Africa and very similar paintings have been described from south-western France and Spain during recent years.

The present volume is concerned with somewhat similar works of art, but these are engraved on the flat surface of rocks with some sharp tool. In some cases an outline is scratched or drawn, in others the whole surface of the drawing is marked out with indentations or pick marks. These Rock-Engravings are found most abundantly in Griqualand West, the western districts of the Orange Free State Province and the Transvaal, and in Bechuanaland and Damaraland. They are not generally associated with paintings, which are more abundant farther south and east, and while the paintings are most commonly found in rock shelters and shallow caves, the engravings are found about kopjes, generally on slabs of rock such as dolerite or amygdaloidal diabase. Although the subjects of the paintings and engravings bear some resemblance to one another, there are certain differences. The engravings usually represent the larger game animals, such as the elephant, rhinoceros, eland, zebra, and occasionally the ostrich. The figures of human beings are much less frequent and the vivid scenes of battles between the pygmy bushmen and the larger kaffirs are entirely absent. In many localities there are also figures and engravings of geometrical patterns, the significance and age of which are quite unknown.

Miss Wilman, who has been associated with the Macgregor Museum at Kimberley now for a good many years, has visited many of the sites in the neighbourhood of Kimberley and has also collected for preservation in the Museum a large number of examples of these peculiar works of art, and in this handsome volume has collected together all the information available in regard to them.

There is a great deal of difference of opinion in regard to the age of the engrav-

ings; some writers consider that they must be assigned to Pleistocene times, others believe that they were made within the last five hundred years. There seems to be little evidence of their great antiquity as they are mostly in exposed situations and would hardly be expected to have survived for so many thousand years, as would be the case if they dated from the Pleistocene. As to who were the artists, Miss Wilman is strongly of opinion that they were engraved by one of the many tribes of Bushmen who wandered over the country before the advent of Europeans or even the Bechuanas and Korannas came to these regions.

The second half of the work consists of a series of reproductions of photographs of sites and of engravings *in situ* as well as of examples now preserved in the Macgregor Museum and a few from elsewhere. The whole forms a corpus of reproductions of a remarkable series of primitive works of art not previously published and but little known to anthropologists.

The volume is beautifully printed and produced by the Cambridge University Press; the cost of publication was borne by the Carnegie Corporation of New York acting through the Research Grant Board of the Union of South Africa. To these and to Miss Wilman we offer our warm congratulations on the completion of a fine piece of investigation on the prehistory of South Africa.

W. L. S.

NORTH AMERICA

THE WOODEN WALLS AMONG THE ICE FLOES: Telling the Romance of the Newfoundland Seal Fishery. By Major WILLIAM HOWE GREENE. *London: Hutchinson & Co.* 1933. 10 × 7 *inches;* xx+298 *pages; illustrations and maps.* 18*s*

The wooden walls of this large and weighty book are the sealing steamers of Newfoundland which in the sixties of last century replaced the sailing vessels and in recent years have been replaced largely by steel-built steamers. There were about fifty or sixty of the wooden steamers, built for the purpose in some cases, or for whaling in others. A few still remain, but most have been worn out, wrecked, sunk during the war, or "sold foreign." There were great names among them: *Windward, Nimrod, Aurora, Terra Nova, Southern Cross*, and others. Full details of the entire fleet are given, but unfortunately for purposes of record the builders' names are omitted. After a general and it must be said rather wordy introduction on the ice, climate, seals, and sealers, Major Greene devotes the greater part of his book to an account of a voyage to the seal patches. Here is so much of interest that no reader will grudge the many pages. It is easy to enter into the excitement of the hunt and share the triumph of being "log-loaded," that is to say, full to every nook and cranny with pelts. There is probably no more perilous "fishery" than this hunt for the "harps" and "hoods." The men may travel many miles over the drifting floes in all weathers, and the marvel is that generally they return to the ship. And then the ships may be nipped, and many have been crushed in the pack: others, too deeply laden, have foundered in heavy weather. In spite of its gift-book appearance the volume is welcome as a full record of a disappearing occupation. There are many photographs and several small maps.

R. N. R. B.

THE GEORGE WASHINGTON ATLAS. Edited by LAWRENCE MARTIN. *Washington, D.C.* 1932. 18 × 14 *inches;* 50 *plates*

It is doubtful whether many English geographers are aware that George Washington, the famous American soldier and statesman, was also a competent surveyor and cartographer. The bicentenary of Washington's birth was celebrated in the United States in 1932, and part of the work of the Bicentennial

Commission was the publication of the Atlas here under review. When he was only a boy of fourteen or fifteen years of age, George Washington already knew the rudiments of land-surveying; he practised the art throughout his life and drew his last map in 1799, the year of his death. The Atlas consists of two parts, the first of which includes facsimile reproductions of twenty-eight maps actually drawn by Washington himself, "seven used and annotated by him, and eight made at his direction." Most of these maps are land surveys of property, and it is believed that Washington "surveyed in the course of his life more than 200 tracts, containing upwards of 66,000 acres of land." But in addition to the maps connected with the acquisition of property, the Atlas includes examples of Washington's cartographic work made in preparation for "landscape gardening, city planning, exploration, transportation, and the arts of war." One map drawn by Washington shows country which he traversed in 1753–4 and contains his note that "a little below the fork is the place where we are going immediately to build a Fort as it commands the Ohio and the Monongehele." The fort was built on a site where now stands the great city of Pittsburgh. This interesting map is preserved in the Public Record Office in London.

The second half of the Atlas contains forty-two maps which show the position of all the places connected with Washington's life. He travelled extensively, and it is said "that at the end of his second term as President of the United States he had himself seen more of the national domain of that day than any other American." All the places visited by Washington have been marked on these maps, which also include the routes followed by him on his military campaigns and the localities associated with him in the towns where he was a frequent visitor. Two maps of a rather unusual character have been made to show the geographical features named after Washington, and the distribution of statues of him in various parts of the world. The first map reveals the fact that, outside the United States, the world contains "22 mountains, rivers, islands, capes and arms of the sea, 16 statues and monuments, 96 streets and plazas, and 11 villages and miscellaneous features," all bearing the name of Washington; the British Isles claiming no less than 24 of these items. The second map shows that in the United States itself, 1 State, 32 counties, 257 townships, 121 cities, towns, and villages, 10 lakes, 9 streams, and 7 mountains are all named after America's first President. The Atlas has an index and a carefully compiled bibliographical list of the 92 maps that are known to have been made by Washington himself. The volume is adorned by attractive compass roses and decorations, some of which are taken from maps drawn by Washington when still a boy. E. W. G.

CENTRAL AND SOUTH AMERICA

NINETY-TWO DAYS. By EVELYN WAUGH. *London: Duckworth* 1934. 9 × 5½ *inches; 238 pages; illustrations and map.* 12*s* 6*d*

In the author's elaborate apology for writing this book he supposes that an experience which for him was worth six months of his time, a fair amount of money, and a great deal of exertion, may be worth a few hours' reading to others, though he himself, as he explains elsewhere, had not in ten years read a book for pleasure. "But why British Guiana? . . . I met a sailor who told me some astonishing stories about the natives of New Guinea, and as I had listened inattentively to the first part of the conversation, that set me thinking about Guiana."

It is a present fashion to pretend that a work of travel has no serious purpose or value; that the author hates discomfort and cannot think why he went; so he opens his tale in a bar or a gambling hell, sketches some queer characters,

suggests that life is all frivolity or incompetence, sees things as they are, and makes them out a bit worse.

Mr. Waugh's account of his ninety-two days has a touch of this quality at the start. In Georgetown so much of one's information on the chances of passage up-country comes casually from conversation in hotel bars that the author wonders how teetotallers ever get about at all. While he was in Georgetown "a gentleman known to his friends as the Blood of Corruption was arrested on numerous charges. He was the leader of a criminal organization called the Beasts of Berlin. They had taken the name from a cinema film; none of them had the remotest idea what Berlin was; they just liked the name. But they were perfectly serious criminals for all that."

He makes amends to Georgetown in a footnote and starts up-country with "Mr. Bain," a District Commissioner, whose advice on stores to take was: "You should be like me. I can go for days without eating—like a camel. That is the way to live in the bush." After leaving his house at Kurupukari, a house in which it was impossible to lock anything up, though under it, between the supporting piles, lived a dozen or so of convicts, Mr. Waugh started on the trail for "Bon Success," on the frontier, with Yetto, a large middle-aged black of unusual ugliness, described by Mr. Bain as "proper Congo"; a moody young policeman named Price; and a pack-horse "which lie down all de time." To strengthen this party he hired a donkey named Maria and a vain young negro named Sinclair. This singular account of a journey under the best official auspices paints a disturbing picture of an old British possession incredibly unused. On the 150 miles or so between Kurupukari and Saint Ignatius Mission, on the Takuta river boundary with Brazil, he was joined for a while by a coloured youth who had been educated at a Scottish university; met two naturalists in the employ of the Empire Marketing Board; a surly Syrian grotesque in riding clothes; a pleasant Spaniard and his wife; and stayed a night with a religious fanatic named Christie whose conversation is brilliantly recorded. Such are the sparse inhabitants of the beautiful Rupununi savannah, with one tiny centre of civilization, the Jesuit mission established by Father Cuthbert Cary-Elwes, and now in charge of Father Mather.

Guided by a servant of the mission named David, half Chinese and half Arawak Indian, Mr. Waugh crossed into Brazil and came to Boa Vista, on the Rio Branco, where among the thousand inhabitants he scarcely saw any one except the school teacher earn anything or spend anything. The plan of getting to Manaos was impossible. Only a Boundary Commission boat was going down, and the Brazilian Commissioner flatly refused to take the author, who cannot hold it against him, because everyone in that district is a potential fugitive from justice. So Mr. Waugh rode back into British Guiana and by the Kaieteur Fall came eventually to Georgetown again. Of this rather dismal adventure he has made an excellent and amusing story, well worth reading for its brilliant characterization of strange people, but seriously disquieting if it is to be taken as a fair account of a British colony.

INTERLUDE IN ECUADOR. By JANET MACKAY. *London: Duckworth* 1934. 9 × 5½ *inches; 214 pages; illustrations and sketch-map.* 10*s* 6*d*

The author is a lady barrister from Vancouver paying a visit to her sister, who is the wife of the manager of a British-owned cable station at Santa Elena, near Guayaquil. She writes well and gives a lively account of the voyage, but insists perhaps a little too much on male advances and how she dealt with them. She compares effectively the easy-going Ecuadorian with his grave Spanish courtesy and the efficient European cable staff, contemptuous of the Ecuadorian and with

poor manners to a visiting fellow countrywoman. After four months at Santa Elena she must go to Quito, to escape "the prevailing lethargy that is half climatic, half gin-and-tonic," and we have a good account of the journey and of society in the capital, but again continual comment on the bad manners of the English and American element in that society. One hopes that she exaggerates a little.

CARTOGRAPHY

TRAVERSE SURVEYS. By J. A. STORY. *London: Crosby Lockwood & Son* 1934. $7\frac{1}{2} \times 5$ *inches;* 88 *pages; diagrams.* 4*s* 6*d*

This small volume on Traverse Surveys will be of great use to land surveyors in this country, and it should foster the use of the theodolite in cases where accurate surveys on a large scale are required. It is doubtful however whether surveyors of the old school will be moved by it, as they will argue that it is an expensive method involving the employment of a more highly trained field surveyor, and the supply of an expensive instrument, and that the computation also requires the tedious operation of looking up sines and cosines. Even in surveys which are reckoned large in this country the Ordnance Survey maps on the 1/2500 scale establish a strong and close control on any work to be carried out. When however a more accurate survey on a larger scale is required, there is no doubt that the theodolite must be used, and then it is necessary that the length measurements should be of the same order as the angular.

The methods set forth of arriving at the results and the arrangement of the work on forms leave little to be criticized. The actual example on Plate III, which shows a closing error of 1 : 6241, is not a true estimate of the error of the traverse, as on inspection it will be found that the author had to introduce corrections to each angle of 55″ or 1 : 3750, before his closure was found to be 1 : 6241. If his aim was only 1 : 1000, then all is well; but if it was 1 : 5000, his angles were not measured with sufficient accuracy. It is preferable in every case that the angular closure should be better than the final closure.

A few notes explaining the effect of Convergency of the Meridians would not have been out of place, and greater simplicity would be introduced into the computations if a subsidiary origin to the south-west and outside of the area surveyed were adopted, thus making all co-ordinates positive. The latter would also simplify the computation of areas.

Lastly, one method of traverse which is more accurate and much more satisfactory in many cases than either chain or compass traverse has not been mentioned, namely, plane-table traverse. W. M. G.

ECONOMIC AND HISTORICAL GEOGRAPHY

LATE TUDOR AND EARLY STUART GEOGRAPHY, 1583–1650: a Sequel to Tudor Geography, 1485–1583. By E. G. R. TAYLOR. *London: Methuen & Co.* 1934. $9 \times 5\frac{1}{2}$ *inches;* x+322 *pages; illustrations.* 15*s*

Professor Taylor is to be warmly congratulated on the production of a book which will be read with attention and with profit by all geographers. It forms the second volume of a series, the third of which is promised at some future date, covering the history of English Geography in what was, perhaps, its most important and distinctive period. The two volumes which are published are not, however, uniform in design except that each has an extensive bibliography: part, indeed, of the bibliography of the present work is supplementary to that of the earlier volume. The present book is likely to appeal more widely, and be more generally useful, because it is both better written and deals with the subject

in a more systematic and geographical manner. The text, which occupies rather more than half the book, is a valuable, if sometimes uneven, commentary on the bibliography, and is divided into chapters dealing with the two outstanding figures of Richard Hakluyt the Younger, and Samuel Purchas, and with geographical topics such as Mathematical Geography, Economic Geography, and the like.

Professor Taylor insists in her preface that the bibliography "is intended to take precedence of the text." In view of that claim, and of the reservation which follows it, that enough help has been given to enable readers to trace manuscript entries, it is a trifle ungenerous to be critical of what is a most valuable piece of work. But it would have been a small task to indicate at least in which library the manuscripts were to be found, and it would have helped considerably to be given more precise information about those which have been printed. A few items have escaped her vigilant search, as, for instance, a manuscript map of Ireland by John Norden, which is in the Public Record Office, and a manuscript by the same writer in the Bodleian Library. She also does not refer to work already done on the subjects which are dealt with either in the bibliography or in the text: this may lead some enthusiastic research workers to assume that there is a field as yet wholly unexploited. References to standard bibliographies, like that of Mr. Godfrey Davies, or those in the Cambridge History of the British Empire, might well have been included. But Professor Taylor has reason to complain that the work was produced at considerable financial cost to herself, and that there is a limit to the amount of money which an academic geographer can afford to spend on a non-popular work of this kind. By extending the sale of this admirable volume, geographers would not only repay her, but would also indirectly help to make the publication of similar works less difficult in the future. J. N. L. B.

WORK AND WEALTH IN A MODERN PORT: an Economic Survey of Southampton. By P. FORD. *London: George Allen and Unwin* 1934. 9 × 5½ *inches; 224 pages; maps.* 10*s* 6*d*

Much attention has been directed of recent years to Southampton. Its great natural advantages have resulted in its becoming the "premier passenger port" of the kingdom; its wharves have been largely extended, and the huge King George V Dock, capable of taking a larger ship than has yet been built, was opened by His Majesty only last year. It is therefore appropriate that this economic survey of the town and port should appear at the present time. The name of the author, Mr. P. Ford, Head of the Department of Economics of the University College of Southampton, is already well known as the Editor of the 'Southampton Civic Survey,' published in 1931. The fact that Mr. Ford has been able to produce this book, in addition to his labours on the Civic Survey and his University duties, speaks volumes for his ability, his industry, and his powers of organization; for it is clear that a work packed with so much material and information as this could not have been prepared without well-organized assistance.

The survey begins with a condensed history of the development of the port during the last 150 years, which is interesting as showing the gradual passing of the ownership and control of the port from the Corporation to privately owned bodies. Another point of interest is the effect of the monopoly enjoyed by the present owners. There was at one time a project to allow another railway company to have access to the port. This fell through, and the author points out how profoundly the future of the port would have been affected by the appearance of a competitor. Whatever advantages might have resulted in other ways from competition, there seems little doubt that the absence of it has contributed

largely to the development of the port. It is, the author says, "the secure knowledge that the gains of enlarging traffic at the docks and by rail will not have to be shared with competitors that has enabled the Southern Railway to embark on its policy of systematic extension."

Succeeding chapters deal with Population, Industries, the Labour Market, and so forth. The three main occupations of Southampton are seafaring, ship repairs (and to a minor extent shipbuilding), and dock work. The wide seasonal and casual variations in these are remarkable, and lead to a discussion on the subject of transference from one occupation to another. Another point that emerges is that, in comparison with other great ports, the opportunities in Southampton for employment outside the three main occupations are few.

Chapters V and VI, which constitute the major part of the book, deal with Income and Poverty, and discuss at length the standard of life of the population. Information is based on (1) a survey of the incomes of heads of all families with school children; (2) investigation of a representative sample of working-class families; (3) detailed examination of certain special groups. Incomes are divided into eight classes, on the Booth system, and tables are given showing the distribution of families in the various classes. Under the second head, the question of what actually constitutes "poverty" is discussed, and the standards on which the investigation is based are defined. On the standard adopted it is found that some 21 per cent. of the sample investigated were below the minimum standard; a very high proportion compared with certain other towns quoted, but it is based on the conditions of the autumn of 1931, when depression was acute.

In the investigation of causes of poverty, it is shown that by far the most serious is unemployment, which accounts for two-thirds of the number of those below the poverty datum. This is an exceptionally high figure, but here again it is due mainly to the date (1931) at which the investigation had perforce to be carried out. While the reason is obviously distressing, the author points out that it contains the germs of hope, since improvement in trade conditions will automatically relieve the situation.

In the chapter on Housing, to take only one of many interesting points brought out, it is somewhat remarkable that the percentage of people living two or more in a room has remained, during the last thirty years, persistently higher (about double) in Southampton than in the neighbouring towns of Portsmouth and Bournemouth. There appears to be no ascertained reason for this. It may be of interest to Southamptonians to learn, from the records of crime, that about three-quarters of the persons charged with offences are born outside the town; also that Southampton comes low in the list of seven leading ports in its percentage of convictions for drunkenness.

There are many more matters of interest in this survey, which cannot be mentioned for lack of space. A final chapter gives "conclusions," which are merely the summarized results of the investigations—that is, the record of the facts ascertained—without deductions. There are four Appendices, the second of which has a valuable note on the possibilities of the use of street maps. There are two maps, one of which, showing the distribution of income by streets, appeared formerly in the Civic Survey. The book is admirably printed.

This work was designed, the author says, as a contribution to our knowledge of poverty, its incidence and causes. Hence, though dealing with Southampton in particular, it has really a much more general application, being in fact "an essay in the economy of cities." We congratulate the author on his clear and masterly exposition of a difficult and complicated subject. It is a work that should be studied by all who are interested in the welfare of our towns and cities, and particularly by those who are concerned in their government. E. M. J.

GENERAL

OUR PRIMITIVE CONTEMPORARIES. By GEORGE PETER MURDOCK. *New York (and London): The Macmillan Company* 1934. 8 × 5 *inches;* xxii + 614 *pages; illustrations and sketch-maps.* 14*s*

In this book eighteen different peoples from various parts of the world are selected and each in turn is described. An account is given of the geographical situation in which they live, their arts and crafts, and their social organization, in such a way as to give a picture of the methods of life of each of them in turn. The book is mainly the result of synthetic reading, but the author has included some of his own observations. The selection has been well done; the author has had two aims in view, first to include a representative geographical distribution, and secondly to cover the greater variations in types of social institutions. He has endeavoured to give the facts about the various races discussed and to avoid as far as possible any bias, taking the mean of various writers. It might be thought that such a process would devitalize his work, but this has certainly not been the case, and the book may be recommended either to students who wish to get some sort of idea how primitive people live or to those whose studies in geography have taken them into other fields but who wish to know something of uncivilized man. L. H. D. B.

BARLOW'S JOURNAL OF HIS LIFE AT SEA IN KING'S SHIPS, EAST and West Indiamen and other Merchantmen from 1659 to 1703. Transcribed from the original manuscript by BASIL LUBBOCK. *London: Hurst and Blackett* 1934. Volume I. 9½ × 6 *inches;* 286 *pages; illustrations.* 18*s*

'Barlow's Journal' is the autobiography of a common seaman, from his early days at home in 1656 until 1703, when he retired from the sea. It is transcribed from a manuscript formerly in the possession of Admiral Sir J. S. Yorke. Barlow began it in 1672, when he was captured by the Dutch on his second East India voyage, "that here people may understand in part what dangers and troubles poor seamen pass through, and also of the manner and situation of most places which I have been at since I first went to sea."

The first volume describes voyages in King's Ships or merchantmen which carried him round the coasts of the British Isles, across the North Sea to Bergen, to the Straits and the Mediterranean, the Canaries and Brazil, or round the Cape to the East Indies and China. Barlow gives a general description of each place he reaches, noting down the produce, the customs, and religions of the inhabitants, and adding a bird's-eye view of most of the ports; these latter are more decorative than accurate, especially those of places which he had visited early in life and which he had to draw from memory. Other of his drawings include landfalls, the strange sights he saw, several battle scenes, and the ships he sailed in; altogether there are sixty-one of his drawings reproduced, five of them in colour.

'Barlow's Journal' may not add much to our knowledge of geography, while the historically important parts are covered by the Journal of Lord Sandwich. But as a record of life at sea before the mast or of a sailor's life ashore in the seventeenth century, it is unique and invaluable. Perhaps the modernization of the spelling of all but place-names and of a rather haphazard number of other words detracts from its value to the student. The book however is popular in its appeal; the story is varied and racily told, and the intimacy and rugged English are so attractive that the last of nearly three hundred pages comes all too soon; we look forward to the appearance of the second volume. G. C.

THE MONTHLY RECORD

THE HEIGHT OF MECCA

Mr. George W. Murray of the Survey of Egypt has communicated to the Society an interesting determination of the height of Mecca made this year by the Chief Engineer of the Egyptian Desert Survey Office, Ibrahimeff Abdel Aal el Sayed. On his pilgrimage to the Holy City the latter carried with him a thermometer and an aneroid and took two readings at Jedda and two inside the Kaaba. From these the Director of the Egyptian Meteorological Service calculates the height as 265 metres above sea-level. Taking into account that the floor of the Kaaba is raised about 7 feet above the ground, this result agrees fairly closely with that of 853 feet (260 metres) given on Hunter's map of Arabia published by the Survey of India in 1910 and stated in the accompanying pamphlet to be the height obtained by the Hejaz railway survey.

THE SALT LAKE OF KATWE, UGANDA

The excellent new publication bearing the title *The Uganda Journal* (the organ of the Uganda Literary and Scientific Society) contains in its second number an interesting article on the above lake, by Mr. E. J. Wayland, Director of the Uganda Geological Survey. Katwe Lake, only about 800 yards from the shore of Lake George, in Busongora, occupies the bottom of an immense cauldron-like hole, its level being nearly 100 feet below that of Lake Edward, though curiously enough early surveys placed it a good deal above the latter. With its blood-red water and sun-drenched surroundings it is for the most part a weird and unlovely spot, but its geological interest is considerable. With other depressions of its kind in the same region, with or without water, it is due to explosive volcanic action, these being not lava-vents, but craters from which masses of rock have been torn at depth and hurled out through pre-existing deposits of sub-aqueous volcanic tuffs. Some of these events must have been witnessed by early man, for the ashes accumulated during the second half of the first Pluvial period, from the deposits of which Mr. Wayland has recovered primitive stone tools, while the explosion craters came into being much later and their formation may possibly find an echo in the folk-tales of the natives. A remarkable fact is the fairly constant level maintained by the water in spite of its slight depth (only about 4 feet in the centre) and the intense evaporation to which it must be subject. It can only be explained on the supposition that it corresponds with the general level of the water-table in this area. The lake is intensely saline, the dissolved substances including large amounts of sodium carbonate and sulphate in addition to common salt, and these occur in varying proportions in the 3-inch solid layer which covers the bottom. It is calculated that there are upwards of 400,000 tons of saline matter in solution, far beyond anything that can be accounted for by visible sources of supply. It is a product of volcanic activity, due to the decomposing action on sodium-bearing minerals of gases and solutions rising from below. Salt of the first grade of purity separates out in crystals on the surface of the water, while a less pure grade is formed in specially prepared evaporation pans. Even the first is never quite pure: it is collected only when at the end of the dry season a strong wind drives it on to the eastern shore. The third grade is broken into slabs while still on the bottom by means of poles: its surface is often beautifully ripple-marked. The Katwe salt commonly displays a delicate blush, due, it has been found, to a coloured protein of bacterial origin.

ITALIAN MISSION IN THE LIBYAN DESERT

In the *Bollettino* of the Royal Italian Geographical Society, February 1934, Professor di Caporiacco gives a brief account of a topographic mission, under the command of Captain Marchesi, to southern Cirenaica. The mission reached Kufra on 15 February 1933, and, after work in the neighbouring oases, members made expeditions to Zieghen, Taiserbo, and Buseima, and, later, to two wells, 40 kilometres north-east of Kufra, which had not previously been visited. At the beginning of April the mission moved to 'Uweinat, where it remained two months. During this period the massif was examined, some of the interior valleys penetrated, and the principal summit, the height of which was calculated to be 1934 metres, was climbed. Towards the end of May the leader with two companions made two journeys of 200 kilometres each to the south-south-east and south-south-west of the massif. The remainder of the time was spent at Kufra.

The work included surveys on the scale of 1/100,000 of Kufra, Taiserbo, Arkenu, 'Uweinat, and other areas; on 1/400,000 of a large portion of southern Libya; and route maps, including one along the new air route between Jalo and Kufra. Observations were made on the form and distribution of the sand-dunes, with a view to the practicability of motor transport; and geological, botanical, and zoological specimens collected, which are now deposited in the University of Florence.

NORTH ATLANTIC SURFACE TEMPERATURE

Publication No. 102 of the Royal Netherlands Meteorological Institute contains monthly charts, accompanied by text and tables in Dutch and English, of the distribution of sea surface temperature over a region in the north-western part of the North Atlantic Ocean bounded by the parallels of 37° and 50° lat. N. and the meridians of 40° and 75° long. W. The charts, which are prepared and discussed by P. M. van Riel, are based on a number of observations, in many cases very large, for each one-degree square, extracted from ships' logs between 1856 and 1925. One set shows the mean sea surface temperature and another the surface circulation in this part of the ocean near the Newfoundland Bank.

The circulation maps are marked by a line of convergence between warm Gulf Stream water flowing north-eastward and cold Labrador Current and coastal water moving southward. This line reaches its most northerly position in July, its most southerly position in January in the western part of the area, but not till the spring in long. 50° W. It may be noted that this is the region where icebergs drift farthest south in the spring. The temperature changes rapidly across the line of convergence, but there is a well-marked transition zone in which irregular variations are often caused by the intermingling of cold and warm tongues of water.

The temperature charts show marked conformity between the course of the isotherms and that of the continental slope, especially during the coldest period, February and March. There is also correspondence between the eastern edge of the Newfoundland Bank and the axis of bends in the isotherms. In August the highest isotherm in the Gulf Stream area is 77° F., the lowest south of Nova Scotia 55°, and in February the corresponding limits are 64° and 32°.

It is pointed out that temperature alone will not decide whether certain volumes of water belong to the cold or the warm area and that reference must be made to other physical conditions, especially salinity.

ICE IN SOUTHERN BALTIC AND DANISH WATERS

A full account of an extraordinary development of sea-ice is given by Johann Richter under the title "Die Vereisung der Beltsee und südlichen Östsee im Winter 1928–29" (*Aus dem Archiv der Deutschen Seewarte*, 52 Bd., Nr. 5, 1933).

It is shown that this winter was the most rigorous in Eastern Europe for ninety-nine years, though it may be noted that in Western Europe several colder seasons could be mentioned within the century, including 1879–80, 1890–91, and 1894–95. The discussion deals with the meteorological situation, the relation of the ice distribution to temperature, salinity, and depth of sea-water, and the drift of a large number of vessels that were beset in the pack. The drift was mainly determined by wind in seas comparatively little affected by tidal currents.

The frost began moderately and comparatively late, for it was not till December 19 that sea-ice was first noted in enclosed situations like the Stettin Haff. During January freezing was slow but continuous, and became rapid with the onset of the acute phase of the frost in February. Throughout this month the entire area of the south-western Baltic, Great and Little Belts, Sound, and Kattegat, was covered either with fast ice, pack-ice, or drift-ice. With the coming of the thaw on March 2 the masses of ice gradually dispersed and drifted eastwards, but pack driven by westerly winds was seen at Memel as late as April 27, and not till April 30 was the last ice noted. The Sound at Copenhagen was frozen for fifty-one days, the ice attaining a thickness of 40 inches.

Most of the thirty-five stations which furnished the data on which this report is based are situated on the land-locked seas in the western part of the area, and there is little information concerning conditions in the eastern part except along the coast. The complete freezing up of the Kattegat suggests a still further westward extension of sea-ice; and in fact we know from other documents that the North Sea was frozen for several miles along the coasts of Denmark and Germany—a very rare event. Ice was formed locally for a brief period in February even on the east coast of England, where some of the tidal creeks were heavily encumbered for a longer period.

THE GENOESE MERCHANT-TRAVELLER, MALFANTE

Some interest was aroused in 1918 by M. de la Roncière's discovery in the Bibliothèque Nationale of a document recording the journey to Tuat in 1447 of a Genoese traveller, Antonio Malfante (see *Journal*, vol. 55, p. 402), on whom further information was given in the same writer's big work: 'La Découverte de l'Afrique au Moyen Age.' In the absence of definite data on the circumstances which led to the journey, M. de la Roncière suggested that Malfante was connected with the Genoese financier Benedetto Centurione, champion of the idea of a gold standard for currency stabilization, whom he supposed to have employed Malfante in the search for new sources of gold supply. An Italian student, Raffaele di Tucci, has since undertaken researches in the Genoese archives with a view to clearing away the obscurities in which the subject has been involved, and has brought to light some new facts which he puts on record in the March number of the *Bollettino* of the Royal Italian Geographical Society for 1934. He first shows that the Malfante family, like others of the period, had formed themselves into an *albergo* or group united for economic or political reasons, and that this group was in close association with those of the Marihoni, Savignone, and Imperiale. An important document is a memorial to the Genoese authorities put forward in 1444 by Percivalle Marihoni with a view to facilitating the return to Genoa of Antonio Malfante, who had left his native land twenty-three years before while still a youth, and had spent the intervening time in continuous journeys in various parts of the world. He was then settled in Spain, and Marihoni feared that he would become naturalized there. This appeal had the desired result. Malfante appears in 1446 at Genoa, as paying not only arrears of tax on a family property, but also that for 1447 in advance, evidently because he was planning to be absent during the whole of that year—the

year in which he made the journey to Tuat. It seems almost certain that he sailed in August 1446 in a merchant ship owned by Marihoni and Savignone (subsequently captured at Cadiz by the fleet of Benedetto Doria, who supported a rival faction at Genoa), from which he had disembarked at Honein for his African journey. It was with these merchants that he was evidently more closely associated, though not immediately concerned in their ventures, and M. de la Roncière's view that he was employed by the Centurione is held to be a mistake. He seems to have amassed considerable means, and to have undertaken the African journey entirely on his own account. The text of twenty different documents bearing on the subject is printed as an appendix to the paper, and from one of these it appears that Malfante died in Majorca in 1450.

LOCAL SURVEYS BY THE SAXTONS

We have received from Mr. W. B. Crump, a well-known Antiquary of Leeds, just too late for inclusion with the note on Robert Saxton's township plan printed in the July number (p. 89), some useful references to other work of the same kind by the Saxtons, father and son. In the *Halifax Guardian* of 25 February 1860 mention is made of a "Survey of some lands of Heath School, Halifax, by Mr. Saxton Junior, Surveyor, on 4 September 7 Jas. (1608–9)." Further details were quoted from unpublished Gough MSS. in the Bodleian Library (written by John Hanson of Rastrick, near Halifax, a contemporary of Saxton's) in a work on 'The Spen Valley,' by F. Peel (1893). On the appointment in 1608 of a commission to survey the Manor of Liversedge reference was made to a survey of "the said demayne lands" by Christopher Saxton, "an experte surveyor." Again in 1614 it is noted that "Mr. Robert Saxton the surveyor and others did . . . divide the Moore of Liversedge amongst the freeholders." It might be worth while to follow the subject further in the Gough papers in the Bodleian.

OBITUARY

SYDNEY DOUGLAS BURROWS

Sydney Douglas Burrows, born in Sydney, New South Wales, Australia, on 14 March 1883, entered the Public Service of Papua in 1909. After a preliminary training at headquarters in routine administration, he was attached to the magisterial staff as a Patrol Officer, and in 1912 was promoted to the rank of Assistant Resident Magistrate. In January 1916, while Acting Resident Magistrate, Delta Division, he was granted leave to join the Australian Imperial Forces, and he served as an infantry lieutenant in France until incapacitated by wounds in July 1918.

In Papua he served with distinction in various parts of the Territory, and from 1912 onwards took a prominent part in the administrative penetration and exploration of the Western and Delta divisions, a duty which kept him constantly patrolling from the Dutch border to the Purari Delta. His most important journeys however were the exploration of the Fly and Strickland Rivers in May–August 1913 and the Upper Fly in May–December 1914. Although second-in-command of both expeditions, the emergencies which arose out of the difficult nature of the work undertaken left him sometimes temporarily in command on both occasions. During these very arduous expeditions he made invaluable geographical and ethnographical discoveries and was highly com-

mended by his leaders. Some of his geographical and ethnographical data are recorded in the published Annual Reports of Papua 1913–14 and 1914–15.

War injuries prevented Burrows from returning to the hardships of Papuan service, but his brother officers, who kept in touch with him, found that his stimulating interest in the exploration and development of Papua continued right to the time of his death on 18 July 1932.

He had been a Life Fellow of the Society since 1918. E. W. P. C.

MEETINGS: SESSION 1933–34

Annual General Meeting, 25 June 1934. The President, Major-General Sir Percy Cox, in the Chair.

The Hon. Secretary (Mr. W. L. Sclater) read the Minutes of the annual meeting and of the special general meeting held on 19 June 1933, which were confirmed and signed by the President.

Then followed the presentation of the medals and awards. In making the presentations the PRESIDENT said: As you know, there are two gold medals, both of equal status, the Founder's Medal and the Patron's Medal. His Majesty has this year approved of the award of the Patron's Medal to Captain Ejnar Mikkelsen for his explorations in the Arctic between 1900 and 1912 and for his work in Eskimo resettlement on the East Coast of Greenland. Captain Mikkelsen's career in the Arctic as explorer and administrative officer has been really a most romantic one, extending over about thirty years. He has put in an extraordinary amount of hard work in the Arctic without, apparently, suffering for it in any way. He commenced his activities in 1900 when he was a member of Amdrup's expedition to South-East Greenland. In 1902–3 he was a member of the Baldwin-Ziegler Polar Expedition to Franz Josef Land. In 1906 he became joint leader with Leffingwell of an expedition in the ship *Duchess of Bedford* to the Beaufort Sea. He described the fortunes of that expedition in his well-known book, 'Conquering the Arctic Ice.' In 1909 he commanded an expedition to North-East Greenland primarily to recover the records of Mylius Erichsen, described in another book by him, 'Lost in the Arctic,' published in 1913. Captain Mikkelsen's other achievements are too many for me to be able to go into the details of them now. His last expedition led him to the Blosseville Coast, and on this he read a paper before the Society, published in the *Geographical Journal* in May 1933. You will thus realize that from 1900 practically up to date Captain Mikkelsen has had an almost unbroken record of Arctic work and exploration. For the last two years he has been absorbed in the resettlement of the Eskimo, and we are glad to be able to congratulate him to-day on having been appointed by the Danish Government to the chief administrative post on that coast, the title of which is Inspector of East Greenland, a very appropriate culmination to a fine Arctic career. Apart from his work for his Government and himself, we have to regard Captain Mikkelsen's career from our own point of view, and I can assure you that no man could have been a more broad-minded and helpful fellow explorer than he has been to our own young explorers who have been to Greenland. They have all set great store by his co-operation and are extremely grateful for what he has done to help them out of difficulties and to give them valuable advice.

Captain EJNAR MIKKELSEN: Mr. President, Members of the Council: May I thank you very heartily for the honour which you have to-day bestowed upon

me, an honour which I value very highly, not least because it comes at the end of my Arctic explorations. And may I thank you, Mr. President, for the very kind words which you spoke of me. I may add that it has been possible for you to use those kind words because of the support extended to me about twenty-five years ago by the Royal Geographical Society and the British nation. When I came over to London your then President, Sir Clements Markham, gave me his valuable support, and I received also the support of the Society and of the Duchess of Bedford. In fact, my first expedition as commander I owe to the generous support I received from Her Grace. Therefore, I say, I owe grateful thanks to Britishers and to the Royal Geographical Society not only for what they have done for me in the past but for the honour which you have now, Mr. President, bestowed upon me and which I fully appreciate.

The PRESIDENT: The Founder's Medal has been awarded to Mr. Hugh Ruttledge for his journeys in the Kumaon and Garhwal Himalaya, extending over eight years, and finally his leadership of the Mount Everest Expedition of 1933. Mr. Ruttledge, as you may know, is an old Cheltenham boy who went on to Pembroke College, Cambridge. He became a member of the Indian Civil Service in 1909 and retired from it in 1931. He seems to have commenced climbing comparatively late in life, from want of opportunity I imagine, and for the first fifteen years of his service he was quartered in the hot plains of India: Lucknow and that part. However, whenever he got his holidays or other opportunity offered he managed to do a bit of mountaineering. In 1901 he was climbing in the Alps, and his ascent of the Matterhorn was the commencement of his serious climbing. In 1925, after fourteen or fifteen years in the plains of India, the Government, in the interests of his health, appointed him as Deputy Commissioner of the Almora District of Kumaon, a part of the Himalaya I know, a piece of country surrounded by splendid peaks, many running to 20,000 feet; really a good centre for climbing at short notice. He did a great deal there. I cannot go into all his achievements as a Himalayan climber, but I would like to mention in particular his ceremonial circumambulation accompanied by Mrs. Ruttledge, of Kailas, the most sacred peak among Buddhists and Hindus, the circumambulation of which rather corresponds to the pilgrimage to Mecca. The man who has performed that circumambulation is entitled to the privilege of being styled "Mahatma," just as a man who makes the pilgrimage to Mecca is termed a Haji. As you can imagine, the ownership of the title of Mahatma and the fact of having made that Buddhist pilgrimage was a great asset when it came to dealing with Tibetans and the business side of an expedition, and when the Mount Everest Committee were considering the selection of a leader for the 1933 Expedition there can have been very little doubt that among those available at the time Hugh Ruttledge was the man to choose; and we all know how efficiently he led it and how he brought his party away after a very difficult time, without a casualty. The only reason why that expedition did not succeed in conquering Everest was the lack of a little bit of the right weather at the last critical juncture. That of course may happen times without number, but we still go on hoping that an opportunity will soon occur to make another attempt, because, as I shall explain a little later, it is our view that we must not leave off trying until we have accomplished the feat.

Mr. HUGH RUTTLEDGE: I am very sensible, Mr. President, of the signal honour which you and the Council of the Royal Geographical Society have conferred upon me. I like to think that that honour is shared by my comrades on the last Mount Everest Expedition; and among those comrades I include the very gallant Sherpa and Bhutia porter corps without whose help we could not have done anything at all. I should also like to think that the honour is shared by my

very constant and perfect companion in the Kumaon Himalaya—my wife. May I take this opportunity to thank Mr. Hinks and the staff of the Royal Geographical Society for the patient and generous help they have constantly afforded me? I would only add that I hope this award does not quite mean the culmination of such services as I have had the privilege of rendering to the Royal Geographical Society, because I hope that time and opportunity may serve for an exploration which is very near my heart, and that is exploration of the south face of Mount Everest. If that cannot be done, at least a very thorough scientific survey of the north face.

The PRESIDENT: The Victoria Medal, instituted by the Society in memory of Queen Victoria and given for conspicuous merit in scientific research, is awarded this year to our priceless Librarian, Mr. Edward Heawood, for his eminence in the History of Geography and Cartography, and his devoted service to the Society as its Librarian. He has been our Librarian now for thirty-three years, and it is with great regret to us that to-day he brings his services in that capacity to a close. During those thirty-three years he has won a most enviable and distinguished reputation among the geographical societies of Europe as an expert and erudite student of maps and old printed books on geographical subjects. He has been of the greatest service to the Council, as you may imagine, in giving advice on those subjects. Apart from that his great claim upon the public gratitude is the fact that he has been a most unselfish and helpful co-operator with all who have come to seek his advice and assistance. I may just give you a few instances of the work which Mr. Heawood has done. He is the author of a 'History of Geographical Exploration in the Seventeenth and Eighteenth Centuries,' and in addition to his articles on Early Cartography, he has contributed largely to the *Geographical Journal;* in fact, work from his pen has appeared in every one of the eighty-three volumes which have been issued since he entered the service of the Society. Finally, he is an acknowledged authority on watermarks in paper, as a result of which he has been able to render most valuable service in detecting forgeries and recognizing real works of art.

The Council, I am glad to say, have reason to hope that they will not altogether lose Mr. Heawood's advice and association. They have conferred on him the title of Emeritus Librarian, an honour which I hope he will enjoy, and at the same time give us the benefit of his knowledge for many years to come.

Mr. EDWARD HEAWOOD: It is hardly necessary for me to say how deeply touched I have been by the generous act of the Council in making this totally unexpected award. I wish to thank you, Mr. President, personally for the most kind and too flattering words with which you have made the presentation. If I say that I find it hard to recognize myself in the portrait you have drawn of me I may be accused of excessive modesty, but I think it is due rather to the awkward gift of a particularly clear vision which has enabled me to see many shortcomings in my work which have not been patent to other eyes. To tell the truth, I was never a studious person in my younger days. I was all for an open-air life, and perhaps hated my books in my school days as much as any average schoolboy. After my return from India I sometimes looked back with regret to the open-air life I led there among the jungles at the foot of the Himalaya, where I wandered alone and often unarmed in search of plants. Apart from books of travel and adventure I was never much of a reader, and when the irony of fate put me in charge of the Society's splendid library I felt rather like a square peg in a round hole. But I took some comfort from the saying current in library circles that a good librarian should not know the contents of the books under his charge, which means, I suppose, that the routine work of a library is so constant and multifarious that a librarian who does his work well has time for little else

unless he burns the midnight oil. That is a vice I certainly have never been addicted to, so that the opportunities I have had for really systematic study have been very small. All the same it would be idle to pretend that, after having had through one's hand practically the whole geographical literature of forty years and more, one had not acquired a fairly wide, if superficial, knowledge of the subject; and I am glad to think that, such as it is, it has been placed unreservedly at the disposal of all inquirers.

But enough of myself. I feel bound to say a few words of the great help I have had from those with whom I have been in contact since I came to the Society. In the first place, the Presidents, from Sir Clements Markham onwards, and the Councils, have given me most generous encouragement throughout. I have also to thank Dr. Mill, my predecessor, for having organized the library work in such an admirable manner that we who have succeeded him have had merely to carry it on in the way he started it. I have further to acknowledge the help of a most loyal and zealous set of assistants. I cannot mention them all by name, but I would like to say that one of them, Mr. Woodrow, has been with me for twenty-nine years. One and all have worked with the greatest goodwill to make the Library both useful to readers and worthy of the Society.

Once more I thank you, Sir, for this greatly valued token of goodwill and approval of the work I have been able to do, which has become so much a part of me that it cannot be relinquished without a somewhat painful wrench.

The PRESIDENT: The first of the awards is the Murchison, and this the Council have awarded to Mr. John Rymill for his work in Greenland and his leadership of the party after the death of Mr. H. G. Watkins, on the latter's second expedition. Mr. Rymill started work in the Arctic with Mr. Watkins in 1930–31, when he was a member of the party which established the Ice-Cap station; and he accompanied Watkins to the relief of Augustine Courtauld in the following spring. On the same expedition he did very valuable work in helping Hampton to build a new 'plane out of the wreck of the old machine and bits of driftwood and canvas. In 1931 he made with Hampton a crossing from Angmagssalik to Holsteinsborg, 450 miles right across the Ice-Cap, carrying kayaks on their sledges. Towards the end of their journey they were forced to abandon the sledges and to carry everything else on their backs for the last 40 miles. Then Rymill became leader of the Second Greenland Expedition after Gino Watkins lost his life, and he brought that expedition safely back, bitterly deploring the loss of their comrade. Now we have to wish him *bon voyage*, for, as you know, he intends to leave in September on an expedition to Graham Land in the Antarctic. His idea is to proceed south from Deception Island and establish a base as far south as possible on Graham Land, or even Hearst Land. With the co-operation of the aeroplane, sledging expeditions will be made into the unknown region beyond the Weddell Sea. In the second sledging season an attempt will be made to reach the limit of the Falkland Islands Dependency, which is 80° W. Mr. Rymill recently gave us an account of his expedition in Greenland, which appeared in the *Journal* for June 1934. The way he shaped on those expeditions has been the reason for the support he has obtained for the great expedition he is about to lead to British Graham Land and from which we hope for great results. The award we make to him now is for what he has done in the past and as a sign of our good wishes for his success in the future.

Mr. JOHN RYMILL: I wish to thank you very much for this grant which I beg to receive on behalf of the three of us who were left in Greenland after Watkins' death. Although I assumed the position of leader of the expedition there was very little I could do in that capacity as we each had our own particular work in the programme which Watkins had worked out. We merely endeavoured to

carry that out as well as we could. Therefore, in this case in particular, I feel that this is an award for the work done by the three of us. I would like to take this opportunity to thank the staff of this Society for the courtesy and very great help which we received while winding up the expedition on our return to this country.

The PRESIDENT: The Back Grant has been awarded to Dr. D. N. Wadia, of the Geological Survey of India, for his studies of the Himalayan axis and other problems of Indian geomorphology of importance to geographers. Mr. Wadia has distinguished himself greatly not only as a member of the Geological Survey of the Government of India but in the able work he has done *qua* geologist in all directions which are of interest also to geographers. He wrote a brochure in 1928 on the Punch State and adjacent portions of the Punjab, and this publication bridges the gap between purely theoretical geology and the geographer. In 1931 he wrote a technical book on the Syntaxis of the North-West Himalaya, its rocks, tectonics, and Orogeny, a publication which settled without doubt the question of the extension of the Himalayan axis. It, in fact, shows that the great Himalayan axis does not cross the Indus. He also wrote on the geology of the beautiful peak of Nanga Parbat and the adjoining portions of Chilas, Gilgit, etc.; and that was followed by another technical work on the Tertiary Geo-syncline of the North-West Punjab and history of Quaternary earth-movements and drainage of the Gangetic trough. On these grounds and on account of the value of his work to geographers, he has been awarded the Back Grant. He has asked that instead of receiving the award in cash he may have it in the form of silver plate, and the silver box to be conveyed to him is as nearly as possible in accordance with what he has asked for. Mr. Zaman, who is on the staff of the High Commissioner for India, has attended to receive the award on behalf of Dr. Wadia.

Mr. S. R. ZAMAN: The High Commissioner for India asked me to apologize for his unavoidable absence and to deputize for him on this occasion. I have to convey to you Dr. Wadia's thanks for the great honour done him by the presentation of this silver box, which I am sure he will greatly appreciate.

The PRESIDENT: The Cuthbert Peek Grant is given not actually for services performed but to help those who are intending to undertake expeditions which the Royal Geographical Society regards favourably. It is granted this year to Mr. Shackleton to assist him in his preparations for his expedition to Ellesmere Land. The name of Mr. Edward Shackleton will, I know, bring thoughts of his father to your minds, and you will join me in expressing the great pleasure we have in seeing Lady Shackleton here this afternoon. Edward Shackleton went as surveyor with the Oxford University Expedition to Sarawak in 1932, and he then made a journey from the base camp to Mount Mulu, the highest peak in Sarawak, which was climbed for the first time. He gave us a note on survey results for publication in the *Geographical Journal*. He has now organized an expedition under the auspices of the Oxford University Exploration Club and with the support of the Royal Geographical Society. He proposes to winter in Ellesmere Land and explore the unknown northern interior between parallels 82° and 83° N. The party of five will be led by Dr. Noel Humphreys, though Shackleton is the organizer, and they will be leaving England in a few days. The Canadian Government have lent a member of the Royal Canadian Mounted Police, who has been stationed in Southern Ellesmere Land. We wish Mr. Shackleton and his party all good fortune in their plucky undertaking.

Mr. EDWARD SHACKLETON: I should like to thank the Society very much for this great honour and also the President for his kind words with regard to my mother and myself. I feel that of all those who have received awards to-day I am the least qualified. As the President has said, this is an award which is given

for work which is going to be done, not for work which has been done. I hope that this will not be unduly optimistic. I feel if it is justified it will be because of the help which the members of the Royal Geographical Society, and in particular two recipients of to-day's awards, Mr. John Rymill and Captain Mikkelsen, have given me. In particular I should like to remind Captain Ejnar Mikkelsen that I owe, as indeed do all who have been in the Arctic, a great deal to the Danish people and to Captain Mikkelsen. The thing that has impressed me most about organizing an expedition is that although one may have the help of experts there are always plenty of others willing to assist and advise. The Canadian Government, for instance, have helped a great deal in the proposed expedition, and they have attached to it one of their most valuable people, Sergeant Stalworthy, who happens to be present this afternoon. The Royal Geographical Society have always been extremely kind and helpful to Oxford University Expeditions, and I feel that this honour that has been done me has been done as much to the Oxford University Exploration Club. I should like to thank you on their behalf.

The PRESIDENT: The Gill Memorial has been awarded to Mr. W. B. K. Shaw for his explorations and studies in the Libyan Desert. Mr. Shaw has made several journeys in the Libyan Desert. He was one of Major Bagnold's companions and his scientific right hand. He accompanied Newbold in the winter of 1927 on an expedition by camel from El Obeid to Bir Natrun, thence to the oasis of Nukheila, or Merga, returning through Selima to Wadi Halfa. They hoped they would be the first Europeans to visit Nukheila, but they found they had been anticipated by Prince Kemal el Din and Dr. Ball. They made the stage from Nukheila to Selima, in the hope of discovering the famous mystery oasis of Zerzura. That entailed a march of 275 miles across a desert without water and scarcely any grazing, and, after all, to their disappointment, they did not succeed in finding Zerzura. In 1930 Mr. Shaw accompanied Major Bagnold's expedition into the desert area west and south-west of 'Ain Dalla and 'Uweinat. That was recounted to the Society and the paper appeared in the *Journal* of July 1931. Mr. Shaw went on that expedition as the botanist and published a note upon his collection, and also upon 'Ain el Kiyeh', in the *Geographical Journal* for December 1931. Again in 1932 Mr. Shaw was a member of Major Bagnold's expedition which explored the Sarra Triangle, and the area south of 'Uweinat and between the French frontier and Merga–Bir Natrun. He assisted with the astronomical work and was responsible for the botany and aneroid observations. He contributed an appendix on 'Neolithic and later times' in Libyan archaeology. These appendices to the account of Major Bagnold's expedition are very important indeed, and with the narrative constituted a very valuable paper in our *Journal*.

Mr. W. B. K. SHAW: Thank you very much indeed, Sir, for the honour you have done me in the award of the Gill Memorial. If in my case it is a reward for having done very little, it is certainly an encouragement to try to do more. In any one year in England many people receive awards and medals. They receive them for rescuing people from fire, for saving them from drowning; in short, for doing a great many unpleasant things. But this very remarkable Society, having first encouraged one by its patronage and then helped by technical advice, by the loan of equipment and often by financial assistance to do what in my case, at any rate, I would rather do than anything else in the world, then astounds one by making an award. I have no more to say, Sir, than to add my voice to the chorus of thanks to Mr. Hinks and the permanent staff of this Society, particularly may I say to those in the draughtsmen's room, for the help they always give one.

The PRESIDENT: Before we proceed to our other business I have the pleasure to tell you that Mr. Heawood, to whom we have presented our Victoria Medal, is also to receive a medal from the Royal Scottish Geographical Society, their Research Medal for 1933. Mr. Heawood was unable to get up to Edinburgh to receive the medal there, and so Lord Elphinstone, President of the Scottish Geographical Society, finding himself in London, has been good enough to come here to-day to make the presentation.

Lord ELPHINSTONE: I will read the extract from the Minutes of the Council Meeting of the Royal Scottish Geographical Society of 18 July 1933: "The Council of the Royal Scottish Geographical Society agree to the recommendation of the Awards Committee that the Society's Research Medal for 1933 be awarded to Edward Heawood, Librarian to the Royal Geographical Society, in recognition of his successful researches into geographical discovery and early cartography as well as for his long, unremitting, and generous help to other researchers while carrying out his duties as Librarian." On their behalf I have the greatest pleasure in presenting this medal to Mr. Heawood.

Mr. EDWARD HEAWOOD: It is a rather trying ordeal for one man to have to return thanks twice in one afternoon, but I feel I have brought this on myself. If I had been a little more ready to put myself out by undertaking the journey to Edinburgh I should have come through this part of it long ago. But I do feel intensely grateful to the Scottish Royal Geographical Society, and particularly to you, Lord Elphinstone, for coming here to-day to give the medal. From what I said earlier you will have gathered that I hardly realize that I have done enough to earn such a reward, but I was pleased to find that in the terms of the award a good deal of stress was laid on the help given to other researchers. I certainly have taken a pride and pleasure in giving any help I could in that way, though when it is a question of a flourishing and vigorous society such as the Royal Scottish Geographical, which is now about to celebrate its jubilee, I do not think any help I could give would be very much needed. But I am particularly pleased at being thus associated with the Royal Scottish Geographical Society, as it is a sort of tangible evidence of the cordial relations that have for so long been maintained between the two Societies. I have had the pleasure and privilege of personal acquaintance with many of the officers of the Royal Scottish Geographical Society. I remember that it was Mr. Silva White, its first Secretary, who took me in charge when, fresh from the jungles of India, I first dined as a guest of the Kosmos Club. I also had the honour of acting as one of the sponsors of Sir Ernest Shackleton when he put up for election to our own Society before ever he rose to fame. I have also been in the most friendly relations with Professor Chisholm, Dr. Bartholomew, Professor Ogilvie, and not least with Dr. Newbigin, the talented editor of the *Royal Scottish Geographical Magazine*. Therefore it is a great pleasure to me to be associated in this way with your Society. Please accept my grateful thanks.

The President then delivered his Anniversary Address, which is printed on p. 97.

The visitors having withdrawn, the PRESIDENT appointed Mr. Cana and Captain Dannreuther to act as Scrutineers of the Ballot for the President and Council for the ensuing year.

The PRESIDENT, in submitting the Annual Report of the Council, said: You have all had a copy of the Report, ladies and gentlemen, and I should like to refer you particularly to the statement on p. 2: "The Council find it necessary to call attention to the fact that a newly elected Fellow who prefers to pay his entrance fee by instalments incurs thereby an obligation to maintain his Fellowship at least until the instalments are fully paid." On the one hand, not quite

as much advantage has been taken of those easy terms as we had hoped. On the other hand, in some cases rather an unfair advantage has been taken of them; thus, there have been cases in which a Fellow paid one instalment, took advantage of his Fellowship and the use of the letters F.R.G.S., and then ceased to pay more, so that we have been put to a great deal of trouble to obtain the remaining instalments. If that continues we obviously cannot adhere to the arrangement made with a view to rendering it easier for candidates to become Fellows.

I do not think the 'Record of the Royal Geographical Society,' brought out in connection with the Society's Centenary, is sufficiently well known. It is really excellent reading, and I hope every Fellow will possess a copy of it.

We have experienced some difficulty with the Eleventh Edition of 'Hints to Travellers.' Mr. Reeves retired while it was in preparation and then his successor, Mr. Gilmore, who was working on it, had to relinquish his appointment for domestic reasons after two or three months' work. It will be seen therefore that the Eleventh Edition has been inevitably delayed. The Secretary has however taken the task in hand personally and has been devoting an immense amount of time to the first volume in order that it may be ready for issue during the coming autumn.

Would any one like to ask any question in regard to the Report?

Mr. Burgess suggested that in the case of new Fellows it might be possible to attach some responsibility in the matter of their subscriptions to the Fellows who proposed them. The President replied that it was a delicate matter, to which however he would give his consideration.

It was reported that as a result of the Ballot all the Candidates proposed by the Council had been unanimously elected by the Meeting (see List, p. iii).

The proceedings then terminated.

THE ANNIVERSARY DINNER

The Anniversary Dinner of the Society was held at the Connaught Rooms on Monday 29 June 1934.

The President and Lady Cox received the company, which included, among the Guests of the Society: H.H. the Amir Abdullah of Transjordan, H.E. the Polish Ambassador, H.E. the Turkish Ambassador and Madame Fethi Bey, Comdg.-Gen. Sir Bahadur Shum Shere Jung, The High Commissioner for Australia and Mrs. Stanley M. Bruce, Sir John and Lady Maffey, The Earl and Countess of Cassillis, The Quarter-Master-General of the Forces and Lady Ready, The Chief of the Air Staff, Lord and Lady Wakefield of Hythe, Lord and Lady Tomlin of Ash, Dr. Heinrich and Frau Wild, and Captain Ejnar Mikkelsen.

After the loyal toasts had been honoured, Sir JOHN MAFFEY, proposing the toast of the Royal Geographical Society, said: The records of the Royal Geographical Society are full of adventurous courage. To-night you must bear with an exhibition of it on my part, for with no qualification I have undertaken the very responsible and honourable task of submitting to you the toast of this famous Society. The explanation is not that I have made my mark in any matter with which this learned Society is concerned, but that I have the honour to belong to the same service as your distinguished President—the Indian Political Service—to which he brought great honour by his strong and tactful handling of the problems of the Persian Gulf for many years before the War. Thence he went on to win a wider fame in the war-time and post-war administration of 'Iraq. He and Lady Cox have a very warm place in the hearts of the Indian Political Service, and indeed of all those with whom the chances of

service brought them in contact. As an old admirer I wish Sir Percy Cox a successful and eventful term of office.

That then is my only claim to speak to you to-night. From the standpoint of a scientific discourse on Geography I cannot fill the bill. As a practical worker in the field covered by the Royal Geographical Society I have no past, and I do not anticipate any future. As a scientist I should be useless and as an explorer I should lose my way.

Geography is a subject which begins in the nursery, and in view of the task allotted to me to-night I have been searching my memory for any early successes on my part, but in vain. I was well content, like some others here, to draw the map of Palestine, that land with homely features and a straight fringe, to improve the outline of Spain with indentations of my own fancy; but this state of innocence could not endure. There uprose the chill spectre of Commercial Geography. What had been beautiful became sordid, and shades of the prison house enclosed the growing boy.

Yet I do not deny Geography. Nobody can do that. In life it is a compulsory and not an optional subject. But happily we can each of us approach it in our own way, almost unconscious of the links which gradually make our geography dear to us. To me Geography has made its subtle appeal through History. Where indeed could one find a more fascinating field of practice and theory, of romance and surmise, than that of Historical Geography?

Turn the pages of the Atlas to the Far East and see where that great mountain barrier lies between the Indian Continent and the vast areas of Central Asia. At the critical point where the rich plains of India are finally and hopelessly hemmed in you observe that the mountain masses have temporarily narrowed and that at this narrow point there is a sword-cut through the iron hills. It is like the narrow stem of an hour-glass. Studying the map and noting these vast areas of human habitation, so majestically separated, so infinitesimally connected, you will conclude that the sword-cut through the mountain barrier cannot fail to have played a part in the history of the human race throughout the ages, since such vast areas, such vast interests must have had some sort of link here. This track is not difficult, though overhung by cliff and crag, and it is only 20 miles long. I can see it in my mind's eye now, for I served in it and near it for many years.

Well, let us go there. You are in the Khyber Pass. Your map has enabled you to draw a correct inference, for here still stand the watercourses which tell of a soil and of a rainfall which no longer exist and which indeed belonged to an earlier world; here in a fanatically Muhammadan country stand *stupas* and other remains of a Buddhist kingdom; through here came the flanking march of Alexander's invasion of India; here the plough still turns up ancient coins of Greek design; here is the track of Muhammadan invaders of India; the avenue to the Great Mogul; and here to the mouth of the Khyber Pass, in 1810, when Napoleon Bonaparte was musing on the exploits of Alexander the Great, here came Mountstuart Elphinstone to talk with the Afghan. Thus it was Napoleon who brought us into first touch with the problems of the North-West Frontier, and thereby Mountstuart Elphinstone became a Founder of the Royal Geographical Society. Napoleon fell, but there came the advance of Imperial Russia across Central Asia and the shadow of the Bear lay over the Khyber Pass. Finally, during the Great War, a German mission established itself at Kabul. Finally? No, not finally, for the geographical conditions make it easy for us to predict that the Khyber Pass has not had its last chapter in world history.

How much in the same vein might be said of the valley of the Nile, where you may stand on a crag overlooking the river and see around you evidences,

preserved in that wonderful desert air, of human effort concentrated throughout the ages along the narrow waterway. The crude rock drawings of prehistoric man, the glories of the Pharaohs, the ramparts of Rome, the churches of a Christian community long since submerged by Islam, and if you wish to be very modern you can pick up relics of the men who tried to relieve General Gordon, their buttons and pipe stems, and you can see the mark of their gun wheels which the desert has held like a parchment.

It is very easy, you will say, to be wise after the event and to make the facts fit the theory. It has been wisely said that History is Philosophy teaching by example. Well, can we not learn something which will enable us to see ahead? Scientific advance in all forms of communication, notably the conquest of the air, has freed mankind from many of the physical bonds which governed and conditioned History in the past. Looking at the future can we not safely predict and assign a new importance to the land of Egypt, for instance, an "aerodrome country," a land of visibility, open climate, open spaces, and open coast, a Clapham Junction buckling together the world routes to Africa and the Far East? Others here are far more qualified than I to read these riddles of the future. But they are worth reading, for we must take care that our statesmen do not lightly surrender in any quarter of the world interests which rightly guarded might prove vital to this country and to the Empire.

It is a task worthy of the trained intelligence of this Royal Geographical Society

> Where old experience doth attain
> To something of prophetic strain.

We know what great names adorn the roll of this Society, what triumphs—triumphs, some indeed linked with tragedy, yet still triumphs—shine in their records; and before I resume my seat I will say a word not on behalf of the explorer, but of the explored.

A few years ago we were seeking on the western borders of the Sudan for road alignments which would take us out of the heavy sands which block the way to Darfur. The Ford car was our chief instrument. Our General, General Huddleston, commanding the Sudan Defence Force, was keenly interested and took a personal part which on one occasion led him far from the usual tracks. He had a staff officer and driver with him. They got involved in heavy sand and night fell upon them. The car was sparking on only three cylinders and was roaring along in jerks, the headlights glowing and unglowing in the manner with which we all used to be so familiar. They were on the edge of the Kababish country where the Arab herdsmen scatter in search of scanty patches of grazing for camels and goats. Here then sat a Kababish guarding his little flock against hyenas and other perils of the night, his trusty spear in his hand. He was possessed by all those midnight terrors which invade the untutored mind—and against which sometimes even the tutored mind is not proof. He had never in his life seen a motor car, and now he saw a fearful roaring dragon, all glowing eyes and smoke, advancing to devour. The first thing the General knew about the Kababish was a yell and a crash as a spear was thrust with great force against the side of the car. The car came to a stop and there stood the Kababish. A few words of Arabic, a handshake—the incident was over and the Arab resumed his vigil as if he had done nothing in particular. Yet I think it was as brave a deed as it is possible to imagine. Consider how easily this might have been a tragedy. British officers attacked by fanatical tribesmen, punitive action, and so forth! And all based on misunderstanding. If we only knew the truth, how many regrettable incidents of the past might be traced to nervous

apprehension, a sudden shy animal reaction, rather than to deliberate hostility. Our explorers must be very patient and considerate when they deal with simple half-tamed people. I know well that without his gifts of sympathy and understanding Wilfred Thesiger would not have carried through his difficult and arduous journey through the Danakil country in Abyssinia.

How majestic can be the resistance to the impact of new ideas! Let me read you a brief extract from the missive addressed by the Emperor Chien Lung to George III of England in 1793 when we were making advances which were not entirely welcome.

> You George III, O King, live beyond the confines of many seas; nevertheless, impelled by your humble desire to partake of the benefits of our civilization, you have despatched a mission respectfully bearing your memorial. . . . I have perused it: the earnest terms in which it is couched reveal a respectful humility on your part, which is highly praiseworthy.
>
> In consideration of the fact that your Ambassador and his deputy have come a long way, I have allowed them to be introduced into my presence. To manifest my indulgence, I have entertained them. . . .
>
> If you assert that your reverence for Our Celestial dynasty fills you with a desire to acquire our civilization, our ceremonies and code of laws differ so completely from your own that, even if your Envoy were able to acquire the rudiments of our civilization, you could not possibly transplant our manners and customs to your alien soil. Therefore, however adept the Envoy might become, nothing would be gained thereby.
>
> Swaying the wide world, I have but one aim in view, namely, to maintain a perfect governance: strange and costly objects do not interest me. If I have commanded that the tribute offerings sent by you, O George, are to be accepted, this was solely in consideration for the spirit which prompted you to despatch them from afar. Our dynasty's majestic virtue has penetrated into every country under Heaven, and Kings of all nations have offered their costly tribute by land and sea. As your Ambassador can see for himself, we possess all things. I set no value on objects strange or ingenious, and have no use for your country's productions.

If I have laid bare some of the problems, some of the difficulties which have called, and still call, for the exercise of many virtues on the part of the Royal Geographical Society, it is only that your attention may be finally riveted upon the manner in which they discharge the task. May they long continue to exercise the high privileges of their Royal Charter, to enjoy the support of patriotic citizens, the munificence of benefactions, and a succession of able and eminent men to guide their councils.

Coupled with the name of Sir Percy Cox, their distinguished President, I now give you the toast of the Royal Geographical Society.

The PRESIDENT, in responding, said: As you know, it is in no personal capacity that I rise to respond to this toast. I do so simply as the mouthpiece of the great institution of which I have the honour to be President; but before I proceed to speak of the Society's fortunes and prospects allow me to make one or two brief personal allusions, which I feel I can do without trenching on the field of the speakers who will follow me. In the first place, I would like to say what a very great pleasure it is to me that the toast of the Society to-night should have been in the skilful hands of Sir John Maffey. As he said, he and I were comrades in the same Department of the Government of India, and now I find him in the position of Permanent Under-Secretary of State for the Colonies. I must say it is a transfiguration which causes me great interest, and I wish him much distinction and success in the high post which he occupies.

Secondly, I would like to assure my friend His Highness the Amir Abdullah, and His Excellency the Representative of Nepal, how glad we are that the date

of our Annual Dinner happened to fall at a time when they were both in England and that they have both been able to accept our invitation. I know I am speaking for you all when I say that is a great honour and pleasure to all of us to welcome them.

Turning now to the health of the Society which Sir John Maffey has proposed in such happy terms, I am glad to say that we have no cause for anxiety on that score. Our health is normally good, and our prospects for the next lecture season are reasonably favourable. But before I say more I must refer briefly to two severe losses which we have suffered in the past year: one a total loss, I am sorry to say, and the other a partial loss. The total loss is that of our veteran comrade and Trustee, Douglas Freshfield. I have paid tribute to him this afternoon, and at the time of his death long and interesting obituary letters were published in *The Times* and in the *Geographical Journal*. All I would say here is that he is a very great loss to us, and we greatly deplore his passing.

The second loss which we suffer is that of our Librarian, Mr. Edward Heawood, who leaves us on retirement to-day; that is to say, he quits the post of Librarian; but, as you heard this afternoon, we are not losing his services altogether, nor his ripe experience and erudite scholarship in the sphere of old maps and ancient books on geographical subjects. We shall still have the advantage of his advice as a Member of Council, to which he was elected to-day.

When Sir William Goodenough retired from the Presidency of this Society last year, after the three years of his enthusiastic incumbency, he handed me the reins of a going concern in a sound condition. For some few years, owing to the currency of the building operations and the sale of part of our property, the finances of the Society had inevitably been in a somewhat fluid condition, but by the time I took over last year the business details of those transactions had been wound up, and our finances had returned to their normal and crystallized condition. We are now once again able to frame our budgets with the preciseness which had habitually distinguished them, and to give reasonable support to expeditions appearing to us to deserve it. I am sorry to inform those of you who were not at the Meeting this afternoon, that Lord Biddulph, who for the last ten years has done yeoman service for this Society as our Treasurer, has felt obliged to resign that office, as he proposes henceforward to live down in his country place, and will find it difficult to attend Council meetings. We part with him as Treasurer with great regret, but I am glad to say that he has accepted the invitation of the Council to become Trustee in the place of Mr. Douglas Freshfield, so that the Society is not losing its association with him or with the great Bank of which he is a Director.

I repeat that our finances are in thoroughly good order, but I must confess to you that though the financial depression which has prevailed during the last few years seems to have come to an end the lagging pinch of the past years is still affecting our membership, as indeed it is that of all clubs and societies who depend on their membership for their annual income. True we now have a small reserve capital, which is of course a most convenient asset; nevertheless we need to do all we can to keep up the numbers of our membership. I beg each one of you to do your utmost in that direction. I am aware that even now, in spite of what has been repeatedly said, there is a sort of impression abroad that to become a Fellow of this Society you have to pass some examination, or have to your credit some definite geographical achievement. But that, as you know, is not the case. The simple creed of this Society is the promotion and diffusion of geographical knowledge. That is all we ask of intending Fellows. But there is no doubt that, if we are to maintain our Fellowship and our high reputation, we must march with the times. That our reputation is still very high,

I firmly believe. Indeed only the other day a cosmopolitan geographer and very widely travelled man said to me: "You do not realize what high prestige your Society enjoys in the world at large and especially on the Continent." That is a high compliment, and I hope we shall try to live up to it.

As I say, it is most necessary that we should advance with the times, and I can assure you that the members of the Council who endeavour to direct your affairs are doing their utmost to keep open minds towards new developments of geography, and to welcome exponents of all aspects of the science which we endeavour to uphold. I will give you an example. If any of you have seen the list of the Council who were elected to-day, you will find that they are not all old fogeys, but that there are among them both representatives of the younger generation—live wires whose names are already beginning to be known—and also exponents of the other branches of geographical knowledge. In fact we are anxious to do all we can to open our arms and our minds to other aspects of geography than those to which we have frequently been supposed to restrict our interests.

Let us look for a moment at the immediate prospects of exploration. Quite recently I read some lectures delivered fifty years ago, in which the lecturers spoke of the gradual shrinkage of the bare spaces on the map of the world, and expressed the opinion that as there was little more exploration to be done we must direct our minds in other directions than that of exploration. Well, exploration has been going on ever since in just the same way, and I, from my own knowledge, could mention two or three directions in which there is still a field for work —countries which have not been at all thoroughly explored—such as the Yemen, and parts of Oman. The Yemen, as you know, has been a good deal in evidence during the last few months, and on the desert side of it I think there is a considerable area which is still unexplored; also on the other side of the great desert, in parts of Oman. Another recent example: only last year a lady traveller —and a very good traveller—Miss Freya Stark, was wandering in Luristan, alone in wild tribal country; and, to the best of my knowledge, some of the territory she visited had never been traversed by a European before. I am sure there is still plenty of exploring left for those who are willing to find it, and there can be no more promising time, from the British point of view, than the present. We have a grand generation of young men coming along who are keen to take advantage of any opening in the direction of exploration. As you probably know, even the public schools have begun to send parties every year to some colony or some half-explored part of the world, where they may enlarge their minds and learn the arts of camp life. Next August Commander Levick is going to take a party of about forty public school boys to the coast of Newfoundland. In that way his boys will learn a great deal, and many of them, I hope, will later on become Fellows of this Society and potential explorers.

To-night we have two or three of this splendid generation with us, either going on expeditions or just come back. First and foremost Mr. John Rymill, who, as you know, is leaving in September for Graham Land in the Antarctic with a fine programme and with cordial support from the Government, from this Society, from some of the great institutions in the City, and from public-spirited individuals. We wish him great good fortune in his quest. Then again we have Edward Shackleton, worthy son of a great father, who in a few days will be leaving for the Arctic—Ellesmere Land—with a small expedition led by Dr. Noel Humphreys. To them too we offer our best wishes for the success of their expedition. Lastly, Mr. Thesiger, to whom Sir John Maffey referred and who is also with us to-night, has just come back from the Danakil country, in the south of Abyssinia. He has been extraordinarily fortunate in penetrating

that wild piece of country and getting through without untoward incident. That must have been greatly due to his own tactful handling of the wild people with whom he has been dealing.

I will not keep you longer, but I say again that I am sure there is still a considerable field for exploration—intensive exploration—and we will do our utmost to further it. I thank Sir John Maffey exceedingly for the kind terms in which he proposed the health of the Society and coupled my name with the toast.

The Hon. FRANCIS RODD, proposing the toast of the Medallists, said: My very pleasant task is to propose the health of the Medallists this year of the Royal Geographical Society. As is known, it is customary with the names of the Medallists to associate the recipients of other awards which the Society has seen fit to give.

In looking through the names of the gentlemen to whom awards have been made, one must, I think, be struck by a sort of family connection. I do not mean a family connection in the sense of ties in blood, but a family connection in the sense of association between them and the recipients of awards in former years. It is rather curious how the names recur in each connection; how people are apt to associate with their kind. In going through this list of names you will see what I mean. Before going on to tell you who these gentlemen are I must remind you that the awards which are given annually are granted both in recognition of services rendered to geography in its widest sense, and also to assist and promote geography among those who are going to work. Moreover these awards are given to people irrespective of nationality, of age, and of specialities.

So it comes, if you go through the names, that you find in the first place that the Cuthbert Peek Grant has this year been granted to Mr. Edward Shackleton. As the President told you, his name is that which a distinguished father bore, a name which is now a classic in exploration. The Cuthbert Peek Grant has been awarded to Mr. Shackleton to assist him in the exploration of Ellesmere Land in an expedition which he has organized—not his first expedition, since in 1932 he went with the Oxford Expedition to Sarawak as surveyor, and in the course of that trip climbed Mount Mulu, the highest mountain in those parts, which had never before been climbed. The leader of the expedition is Dr. Noel Humphreys, who last year was the recipient of the Murchison Award. That is the beginning of what I mean by a family connection between explorers.

The Murchison Award this year goes to Mr. John Rymill, to help him in his exploration of Graham Land. His name will be known to those who have followed Arctic exploration in recent years, for he was with Watkins' expedition as surveyor in Greenland in 1932. When Watkins, himself a Gold Medallist of this Society, lost his life in the course of a second expedition to Greenland, Mr. John Rymill took over the leadership. On that expedition to the Lake Fjord district of Greenland Mr. Rymill and his two companions, Mr. Rylie and Mr. Chapman, were fortunate enough to make a meeting with and receive much assistance from, Captain Ejnar Mikkelsen, of whom you will hear further this evening. Captain Ejnar Mikkelsen at that time was returning from an expedition to the Blosseville Coast, of which Fellows of this Society have heard in a lecture he gave. Thus did the recipients of two awards from this Society co-operate in the exploration of a country no less than a year ago. It is unnecessary to say what probably most of you already know, that Mr. Rymill is leaving in the late summer for two-and-a-half-years' absence in Graham Land, as leader of the largest and most important British Antarctic expedition on land since the days of Scott and Shackleton.

The President spoke of the breadth of interest which this Society includes in

its activities. We have dealt with two awards for and to encourage Arctic exploration; to show that breadth we now turn to the tropics. The Gill Memorial this year is awarded to Mr. Shaw, formerly of the Sudan Forestry Department, who in the course of several journeys in the South Libyan Desert has added enormously to our knowledge of Libyan archaeology. He would say perhaps that that area was not so arid but that as a botanist he also found work to do. In 1927, with Mr. Newbold of the Sudan Civil Service, he undertook a most remarkable journey in the classical manner by camel, from El Obeid to Bir Natrun, and on to Wadi Halfa by way of Merga and Nukheila, in the course of which Mr. Newbold and himself did no less than 275 miles with no water and very little grazing for the beasts. In 1930 he was with Major Bagnold west and south-west of 'Ain Dalla and 'Uweinat; and in 1932 he was again with Bagnold on an expedition in motor cars to explore what is known as the Sarra Triangle. His results have been published in various learned papers, and his work has been, we may say, invaluable; though that is not the limit of his travelling, as he has, I understand, only a week ago returned from an archaeological expedition at Gaza.

In the tropical field another award is given this year to a distinguished British Indian, Dr. Wadia, who receives the Back Grant. You will remember that last year another distinguished British Indian was awarded a grant: Afraz Gul Khan, a soldier who from his regiment, the Khyber Rifles, has accompanied most of the more important expeditions in recent years to Persia, to the Karakoram, to the glaciers of the Himalaya, and the Shaksgam. The Indian precedent was thus continued this year by the award of the Back Grant to Dr. Wadia, a man of science and letters, for his work on 'The Geology of India,' which to-day is a standard work, though his main claim to recognition in the geographical world is for the studies which he has made of the trend of the Himalayan axis.

It is customary for this Society to award in every year two gold medals, but in certain years another medal, the Victoria Medal, is also awarded as a recognition for distinguished scientific and literary work in the geographical field. The Victoria Medal was not awarded last year, but since the war it has been awarded to such distinguished scientists and geographers as Brigadier Winterbotham, Colonel Close, M. de Margerie, Professor Coleman, and, in recent years, to our own beloved instructor, Mr. E. A. Reeves. When therefore we find that this year the Victoria Medal is awarded to Mr. Edward Heawood, who has been Librarian to the Society since 1901, we have sufficient information to place him in our minds as the most eminent of geographical historians. The wording of the award is, that he has been given the Victoria Medal "for his eminence in the History of Geography and Cartography and his devoted service to the Society as its Librarian," services which have extended over a whole generation of man. By his contributions to the *Journal* of the Society—I think it is right to say that he has contributed to every one of the last eighty-three volumes of the *Journal;* by the product of his research into early maps; by his monographs on certain map publications which the Society has made; by his authority on the water-marking of paper by which early maps may be recognized; by the fact that his advice is sought by compilers and museums all over the world;—you will know that the award of the Victoria Medal this year has fallen upon shoulders at least as distinguished as those of his predecessors.

The two gold medals this year, which, as you know, are considered to be of equal standing, are awarded the first to Captain Ejnar Mikkelsen, the other to Mr. Hugh Ruttledge. In looking at the list of the awards of gold medals since the war, we find the names of four distinguished Scandinavian geographers—Vilhjalmur Stefansson, Knud Rasmussen, Lauge Koch, and Carsten Borchgre-

vink. With these is now associated the name of Captain Ejnar Mikkelsen, who for the last thirty years has devoted his life to Greenland. His first independent expedition, in 1909, was to recover the records of Mylius Erichsen in north-east Greenland. Since then he has been on numerous expeditions, such as that of 1924 to Scoresby Sound, to establish a colonization enterprise of Eskimos, on account of the Scoresby Sound Committee. The enterprise was successful and the colony was handed over to the Danish Government, and has been going ever since. In 1925 he was on the west coast of Greenland; in 1932 he was again in Greenland on the Blosseville Coast, where, as I told you, he made junction with Mr. John Rymill and his companions on Lake Fjord, engaged as he was then in establishing a chain of huts from points of refuge and settlement between Scoresby Sound and the southern Eskimos. On that expedition he was accompanied by two Englishmen, Mr. Wager, who was on the Mount Everest Expedition, and Mr. Michael Spender, from which you will see that the breadth of Captain Mikkelsen's views about geography enables him to include foreigners, so far as he is concerned, on his expeditions on the same basis as his own nationals. We are glad to hear that since then Captain Ejnar Mikkelsen has had recognition for the work that he has done, in his own country, by being appointed Inspector of East Greenland. I assure him you will all wish, when you come to drink his health, that he will have prosperity and success in his appointment.

The Founder's Medal, which was instituted in memory of His Gracious Majesty King William IV, is awarded to Mr. Hugh Ruttledge. Here again we find that cross-connections with other recipients of awards. In 1927 he was travelling over the glaciers of Trisul with Dr. Longstaff, himself a Gold Medallist of this Society, and who is now in the company of another Gold Medallist, Dr. Wordie, in Arctic Canada. Mr. Ruttledge comes from the Indian Civil Service, where he concluded his career as Deputy Commissioner of the Almora district of Kumaon. In this capacity he had the opportunity of travelling and climbing in the higher mountains of the Himalaya. In 1926 he was climbing on Nanda Devi, and in the course of that expedition he crossed the pass known as Traill's for the first time in sixty-four years. In 1927 he was on Trisul, in 1929 he was climbing again on the central peak of the Panch Chulhi, and in 1932 he was climbing in Garhwal. It was therefore normal and perhaps natural that he should be selected as leader of the Everest Expedition, his account of which you heard in the Society last year. What happened on that expedition it is not for me to tell you. Most of you probably know. But I think it is right and interesting to remind you that one of the conclusions to which Mr. Ruttledge came in giving his account of that expedition—it is, I think, the seventh conclusion in his paper—was "That Mount Everest will be climbed some day, I have little doubt; but it will need the coincidence of at least two things: firstly, not less than three days' consecutive fine weather; and secondly, the simultaneous reaching of the top of their form by no less than four men, and preferably six."

Those words perhaps are a clue to the reason why the awards and medals are given at all. They are given not necessarily for success, still less for spectacular achievements. They are given for the efforts that men and women have made in their different spheres to further geography in its widest sense. The fate of most explorers unfortunately is that of unfulfilled achievement. None of them, or of the men who work with them, would probably ever admit that they had wholly succeeded in doing what they set out to do. But by doing what they have done they have enabled their successors to go further, just as they themselves have walked in the paths of their predecessors. So it seems to me that in giving the awards and medals that this Society annually does, it seeks not only to perpetuate the memory of efforts made, whether successful or otherwise, but also

to perpetuate a certain spirit which has made these men go out in their various branches of geography to further our knowledge of the world. It is that spirit which will continue until the last great peak has been climbed, the uttermost ocean has been travelled, and the last worst desert has been mapped. It is that spirit therefore, ladies and gentlemen, which we celebrate, and to which, coupled with the names of the recipients of the medals this year, I ask you to drink. In the words of the poet, who might have written the verse about those very people who this year have been granted awards:

> Youth's passion, manhood's fierce intent,
> With age's judgment wise,
> They spent, and counted not they spent,
> At daily sacrifice.

I give you the toast of the recipients of the awards of the Royal Geographical Society, coupled with the names of Captain Mikkelsen and Mr. Hugh Ruttledge.

Captain EJNAR MIKKELSEN, in responding, said: This afternoon, in the House of the Royal Geographical Society, I tried to express my thanks for the highly appreciated honour this world-famous Geographical Society has shown me by awarding me the Patron's Medal. I should however like to do it now again before a greater audience, and add to my formerly expressed thanks this, that I consider it so much the more an honour as the greater part of my travelling days have been spent along the coast where your famous countryman of yore, William Scoresby, junior, a man of strange career, first whaling captain, then scientist, and at last bishop in Australia, made his scientific mark, and drew the first rough sketch of the east coast of Greenland. Several names of former famous Englishmen are to be found along the coast, and I rejoice that it has been my good fortune to be instrumental to bring Eskimo settlers to the huge Fjord which for ever will keep the memory of Scoresby alive.

Amongst other names which Scoresby bestowed on headlands, fjords, and islands along the East Greenland coast we find an island named after this Society—a bad enough name for an island to have as it is decidedly too long—but nevertheless a naming, which we have all reason to be proud of, as until the day of doom the island will stand as a huge beacon on undisputable Danish land, commemorating the past, the present, and the future fame of the Royal Geographical Society.

The splendid work done by Scoresby gave us Danes the impulse to begin in earnest the exploration of the east coast of Greenland, and since his days many Danes have done their bit of work along its bleak, forbidding, but lovely shores, as well scientifically as practically, and as I said before, Eskimos now roam over the land which Scoresby found depopulated and make a fairly good living there.

For many years—a century or more—you Britishers did not follow up the work of Scoresby, but we Danes have been very pleased of late to see again the British colours along the East Greenland coast, where Mr. Wordie has done his part of the work, and Gino Watkins, with his splendid team of young British manhood, made travels along the coast and over the forbidding Ice-cap, which raised our deepest admiration. And while rejoicing when your brave compatriots made good work, we Danes participated deeply in your sorrow when death took its toll and you lost an exceedingly good man, whose memory will live alike in England, in Denmark, and in Greenland.

We Danes have had our strife about East Greenland, and not with all nations do we—or I—feel the band of comradeship as with you Englishmen, with whom we have delighted to work and been staunch comrades in arms against the

alluring unknown, and I feel it a pleasant duty to-night to thank the Englishmen it has been my good fortune to meet in Greenland, and not least those who threw their fortunes in with me and were my comrades and friends on the expedition along the Blosseville coast in 1932.

Last, but not least, my most sincere thanks are due to the Englishmen who many years ago gave me the start in my exploring career when I was still too young to be believed in by my own people, namely Sir Clements Markham, who gave me the moral and substantial support of this Society, and Her Grace the Duchess of Bedford, who gave me the first money for my first independent expedition.

And if I to-night may express a wish, let it then be this, that you Englishmen do not again drop your interest in Greenland, that there always will be found young men in your country who listen to the call of the unknown, and no less important, that there always will be found men and women with their hearts and purses open to enable adventurous youth to follow their hearts' desire; believe me—I have ample experience—nothing is so hard and nerve-racking as to try to raise funds for an expedition; smooth the path for the man who unselfishly tries to keep up the high standard of British exploration.

There is still work enough to do in Greenland or the Arctic in general, and may I add a few words, which I know is the ardent wish of the Royal Geographical Society, its members and friends, namely that the expeditions which now are in the field high up north, and those who shortly will start for the unknown in the extreme north and the extreme south, may meet with success, come back full-numbered, and bring with them such results as will be to the everlasting honour of Great Britain and the Royal Geographical Society.

Mr. HUGH RUTTLEDGE also responded, and said: May I begin by thanking very cordially Mr. Francis Rodd for the kind and understanding words in which he proposed this toast and you, ladies and gentlemen, for the kind way in which you received it. Almost exactly at this time eight years ago Brigadier Norton stood in my place on a similar occasion as leader of the 1924 Mount Everest Expedition. Unfortunately I cannot say what I was going to say about him, because he is here, but I must say this: that it was the proudest day of my life when I was appointed to follow in his footsteps, and that no finer leader ever led an expedition. On that occasion he was the recipient of the honour which I in my turn have been privileged to receive to-day.

In returning thanks to the Royal Geographical Society this afternoon I ventured to say, and I propose to repeat it here, that I feel that that honour is shared by our splendid predecessors in previous expeditions by whose experience and sufferings we benefited; it is shared by my comrades of last year's expedition on Mount Everest, and by those splendid Gurkha non-commissioned officers and the Sherpa and Bhutia porter corps, without whose help we could have done nothing at all. Again, I think it is shared by my constant and most perfect companion during my early travels and climbing in the Kumaon Himalaya, my wife.

I sometimes think that mountaineers must be a source of trouble, worry, and annoyance to true geographers. They have a habit, of course, of prying into places which had much better be left alone. They indulge in a jargon, quite incorrectly pronounced, of arêtes, couloirs, séracs, and so on. They rarely wash; they eat the most horrible food; and their clothes are beyond hope. Sometimes, owing to their abominable habit of not complying with the law of gravity, they fall down and hurt themselves. They expect people to be interested in the number of breaths they take to a step, another outrageous phenomenon that need not occur at all. To put it shortly, I think the real geographers may

be pardoned for thinking that a mountaineer's life may approximate to that of Hobbes's "Natural Man," whose life was "nasty, dull, brutish and short."

Yet perhaps, after all, mountaineers are able to contribute some little thing to science. They learn a good deal, I suppose, in a practical way, about physiology, though here again they are a great nuisance, because physiologists have made the most devastating experiments on their own persons, and announced that there is not the slightest hope that a man will be able to exist at a height above 20,000 feet; and then Norton, Wager, Wyn Harris, Shipton, and Smythe go to 28,000 feet or so, sleep a night or two, and come down certainly none the worse. So the experiment has to start over again. And then mountaineers add something to geology, to the knowledge of the structure of the earth; to meteorology; to the knowledge of the structure of ice and snow and their respective movements: and I think we may claim that they explore very far into the physical and perhaps spiritual capacities of man. Finally, now and then, they contrive to find a peak which geographers have already been at pains to discover and put on the maps for them. They endeavour to climb it and, whether they succeed or not, they come home and are given Founder's Medals. So you see that the science of geography does appear to breed a breadth of mind and a gentle tolerance.

Personally, I feel I can be bolder, and say it breeds a very great kindness of heart. I shall never forget, during the stress of last year, what great pleasure it was to receive the mail from home, because in the mail there would be invariably letters of the most kindly encouragement from Fellows of this Society. I think of letters from a previous President and Gold Medallist, Sir Francis Younghusband, a man who has done more than any one else to keep the ideal of Everest before us. I think of Sir William Goodenough, who supported me through thick and thin, from the very beginning; and I think of Mr. Hinks who, though a very busy man, found time to write me accounts of how things were going at home and to help me in every possible way. And I must not forget also the great gratitude due to men like General Bruce and Dr. Longstaff. In spite of the annoyance that we cause the geographers, I am happy to be able to tell you that your present President, far from endeavouring to discourage us, is very actively aiding and abetting an attempt to get another Everest expedition going.

It seems to me there are, from the mountaineering point of view, two things that may be done in the future, and which may contribute something to the service of the Royal Geographical Society. One is the small kind of exploration which I have been lucky enough to be able to do a little of, in the Kumaon Himalaya. That is the kind of work which men who cannot join big expeditions, and who have but limited means of their own, can do. It does not involve anything in the way of record making; it is not sensational, and there is no publicity; but it is one of the finest and most enjoyable pieces of work you can do, and I think it must contribute something to supplement the magnificent work of the officers of the Survey of India. Secondly, of course, there is the ambition to renew the attack on Mount Everest. You will agree with me that we must not let that drop. Perhaps the finest piece of exploration that could possibly be done would be the complete exploration of Mount Everest from all sides, which would need to include a proper and scientific survey. I very much hope that will be possible before long.

Field-Marshal VISCOUNT ALLENBY, proposing the toast of the Guests, said: It is my easy and yet honourable duty now to offer you the toast of the Guests, that is, those guests who have not already been mentioned in the eloquent speeches we have heard. Among those who honour us by their presence here, we have our old and valued friend H.E. the Polish Ambassador, our newer but equally honoured friend H.E. the Turkish Ambassador, and also our honoured

friend the Envoy from that State on the borders of India, Nepal, who will remain as Minister of that great State. We have the High Commissioner for Australia, the Right Honourable Stanley Bruce; the Colonial Office is represented by Sir John Maffey, whom you have already heard. Science is represented by the Director of the Science Museum, Brigadier Mackintosh, whose predecessor is well known to the Royal Geographical Society. We have another great scientist, Dr. Heinrich Wild, the inventor of the Wild theodolite, and Frau Wild. We have the Earl and Countess of Cassilis, he, a Fellow of the Royal Scottish Geographical Society. We have Lord Wakefield of Hythe. We have a great lawyer, Lord Tomlin of Ash, Lord of Appeal; above the ordinary man, he is also above the law, that is, he puts the law right when it goes wrong. Imperial defence is represented by Air-Chief Marshal Sir Edward Ellington, and by General Sir Felix Ready, the Quartermaster-General to the Forces. Then the attack on Mount Everest is recalled by the presence of Air-Commodore Fellowes, who is with us to-night. I must not forget the ladies who have honoured us with their presence and have graced our tables; those ladies who have inspired their husbands, their brothers and other relations, to do the great things in which the Royal Geographical Society is so keenly interested. I ask you, my lords, ladies and gentlemen, to rise and drink to the health of our Guests.

The HIGH COMMISSIONER FOR AUSTRALIA, in responding, said: At this hour of the night I will not attempt to reply for the distinguished list of guests you have heard read out. I will leave that to the eminent lawyer who will follow me. I have however been rather wondering why I, as representative of Australia, should have been asked to reply. I can only think that possibly it is that we have contributed to the work of the Royal Geographical Society in the early days of our existence by providing a most admirable venue for young explorers connected with the Society. There is something else that I think we have contributed. The President has suggested that some misguided persons are tending to think that the task of the Royal Geographical Society has disappeared, because everything that is to be learnt about the world's surface has been found out. We have made an admirable contribution there, because recently, with the aid of modern science, we have managed to discover for you a new tract, which is some 4000 square miles of plain-land, in the interior of New Guinea, that nobody ever had the remotest idea was there at all.

The only comment I would make at this hour is that it seems to me that modern science has assisted very greatly in making easier the task of the explorer, but, at the same time, it has certainly made very much more difficult the task of the unfortunate persons who have to try to run any country to-day. Modern science is really making our problems much more difficult.

We have been asked to come here to-night as guests of the Royal Geographical Society. I have come to the conclusion that we have been asked so that we might be inspired in our daily life in facing the tasks that lie before us. We have been reminded of the wonderful story of exploration and the remarkable courage that has been shown by explorers in the past. We have been singularly lucky to have been here and to have listened to Captain Mikkelsen's speech, because he has given to us all the inspiration of international co-operation that exists amongst those gallant men who meet in strange lands. They know no distinction, but, as Captain Mikkelsen has, I think, so graphically said, they are comrades in arms in facing the unknown. And are we not all comrades in arms in facing the unknown? What lies ahead of the world? It is only by international co-operation, by being comrades in arms, that we can overcome the many difficulties that lie ahead. Therefore I think it is a great inspiration to all of us that we should have been permitted to be here, to hear the words of Captain Mikkel-

sen. We should all go away from these tables with greater courage and with even more determination to carry out the task that lies to our hands. In the admirable speech we heard from Mr. Rodd, proposing the toast of the Medallists, what struck me more than anything else was the passage in which he pointed out that these gallant men go into all quarters of the world and to unknown places, realizing that they can never achieve their full objective and all they would desire to accomplish but, as he so admirably put it, satisfied to build upon what has been done by their predecessors in the hope that they are paving the way for their successors. If nothing else has been an inspiration to us to-night, I think that must have been. Because of what I have heard—and the reply on behalf of the rest of the guests I leave to my distinguished successor—I beg, Sir, to extend to you my grateful thanks for inviting me to be your guest to-night.

Lord Tomlin of Ash also responded, and said: Happily it is not often that Australia follows on, and it has not done so to-night, but, as usual, has left a pretty stiff task for those behind. However, having regard to the clock, the innings of England is going to be short. I confess that when I regard the functions and fame of this Society, which is our host, and the galaxy of cosmopolitan distinction among the guests, I cannot conceive why I have been selected as one of those to respond, unless it possibly is that the intention was not only to do honour to Australia but to do honour to Lincoln's Inn, of which both Mr. Bruce and I are Benchers. My only geographical achievement has been limited to getting from Temple Bar to Westminster. I belong to that category of people which is settled in a district not very far from the Strand, and a man who lived in Arundel Street (which, as you will remember, runs between the Strand and the Thames) made this little rhyme about his street:

> At the top of the street the lawyers abound
> And down at the bottom the barges are found.
> Fly, honesty, fly to a safer retreat,
> For there's craft in the river and craft in the street.

But it had an answer, because he quoted those lines to a lawyer, who replied:

> Why should honesty fly to a safer retreat
> From the barges and lawyers, 'od rot 'em?
> For the lawyers are *just* at the top of the street
> And the barges are just at the bottom.

That is all my claim to respond to this toast. But, listening to the President and the High Commissioner for Australia, I have been wondering whether the world is as satisfactory to the Royal Geographical Society as it used to be. Of course those terrible scientists like Sir James Jeans tell us that the Universe is both finite and unbounded, or perhaps it is bounded but infinite, I forget which —it is one or the other—but at any rate it is slopping over and increasing. At the same time the inventors seem to me to make the world contract, and I suppose the only hope for the Royal Geographical Society in the future is, that when the world has contracted so that they cannot do work here, they will explore the Universe which is slopping over. However, that is not in the immediate future. I confess I am *laudator temporis acti*, and I cannot help thinking that even to the Royal Geographical Society the old world must have been pleasanter for explorers. A pleasant picture of exploration was suggested by the verses which *The Times* recalled to our memory a few days ago:

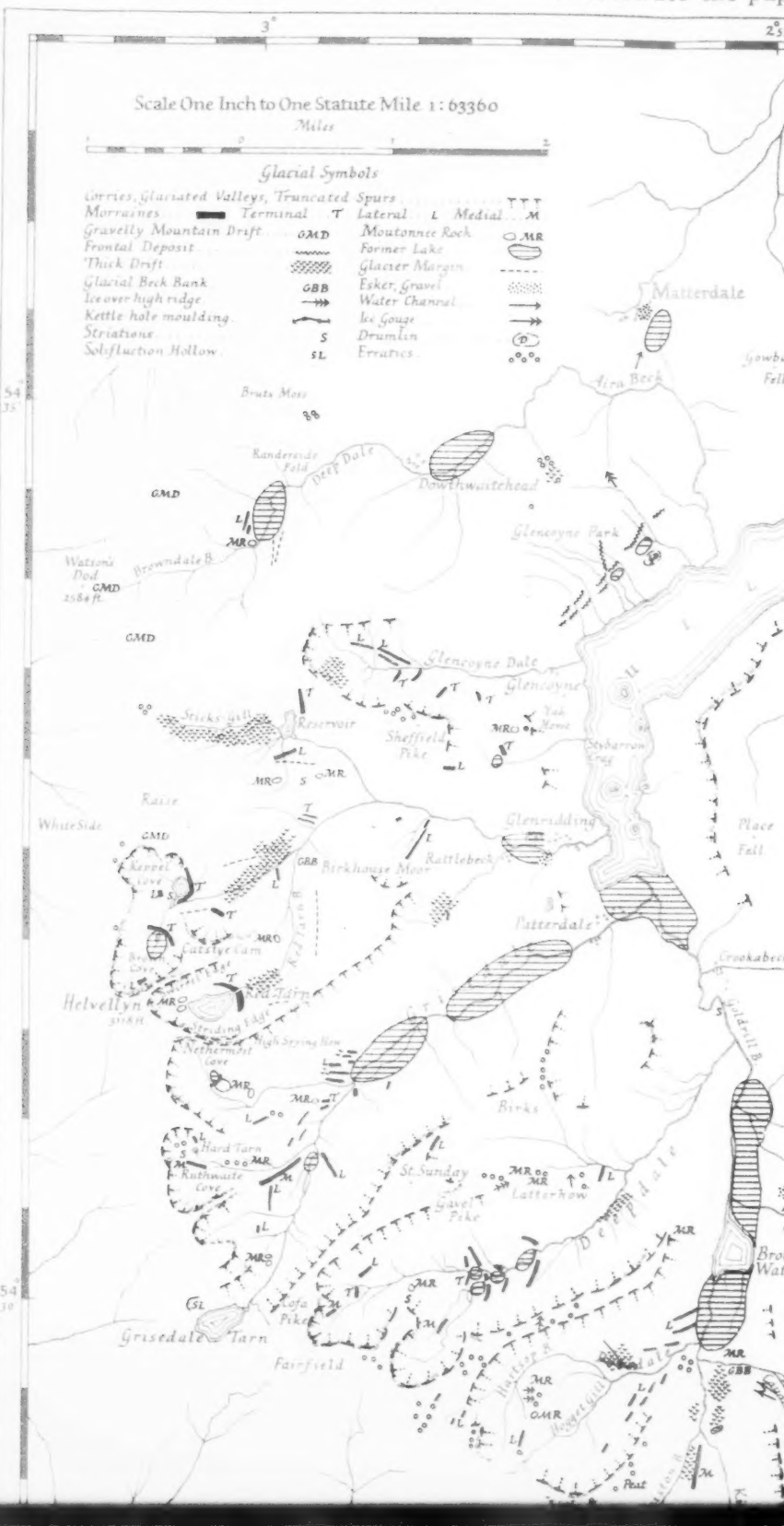
> Slices the natives bring of ham and tongue,
> And from the trees the ready bread fruit hung;
> Pleased with the gifts, the navigator smiles
> And names the favoured spot the Sandwich Isles.

Those must have been very much happier days than these for the explorer.

I think perhaps I may venture to tell you a story to illustrate the dangers of going abroad. I rather hesitate, but after all it came to me from a bishop, so I think I may repeat it here. The horrors of not being able to spell was what the bishop meant it to illustrate, but it seems to me it also illustrated the dangers of being abroad. A small boy in New Zealand who had been through the recent earthquake wrote home to some friends to give an account of it. He said: "The most awful things have happened, and our vicar had a dreadful experience; he woke up in the morning and found by his side a yawning abbess." Well, ladies and gentlemen, it is time to sit down. Thank you very much. I have enjoyed the evening immensely, as I am sure everybody else present has. I am very grateful to you, and so are all your guests.

THE GILF KEBIR: A CORRECTION

The two upper photographs facing page 477 in Dr. Ladislas Kádár's paper, "A Study of the Sand Sea in the Libyan Desert," *Geographical Journal*, June 1934, were erroneously attributed to Dr. Kádár. They were actually taken by Mr. Hans Casparius. The maps included in Wing-Commander Penderel's paper showing the route and the work of the expedition under his leadership embodied new detail of the Gilf Kebir from the surveys of Dr. Kádár, the geographer of the expedition.—ED. *G.J.*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Glacial Beck Bank GBB
Ice over high ridge
Kettle hole moulding
Striations S
Solifluction Hollow SL
Moutonnee Rock MR
Former Lake
Glacier Margin
Esker, Gravel
Water Channel
Ice Gouge
Drumlin D
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Matterdale
Aira Beck
Bruts Moss
Randerside
Deep Dale
Dowthwaitehead
Glencoyne Park
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Sticks Gill
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Sheffield Pike
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White Side
Glenridding
Rattlebeck
Birkhouse Moor
Patterdale
Helvellyn
Nethermost Cove
Birks
Hard Tarn
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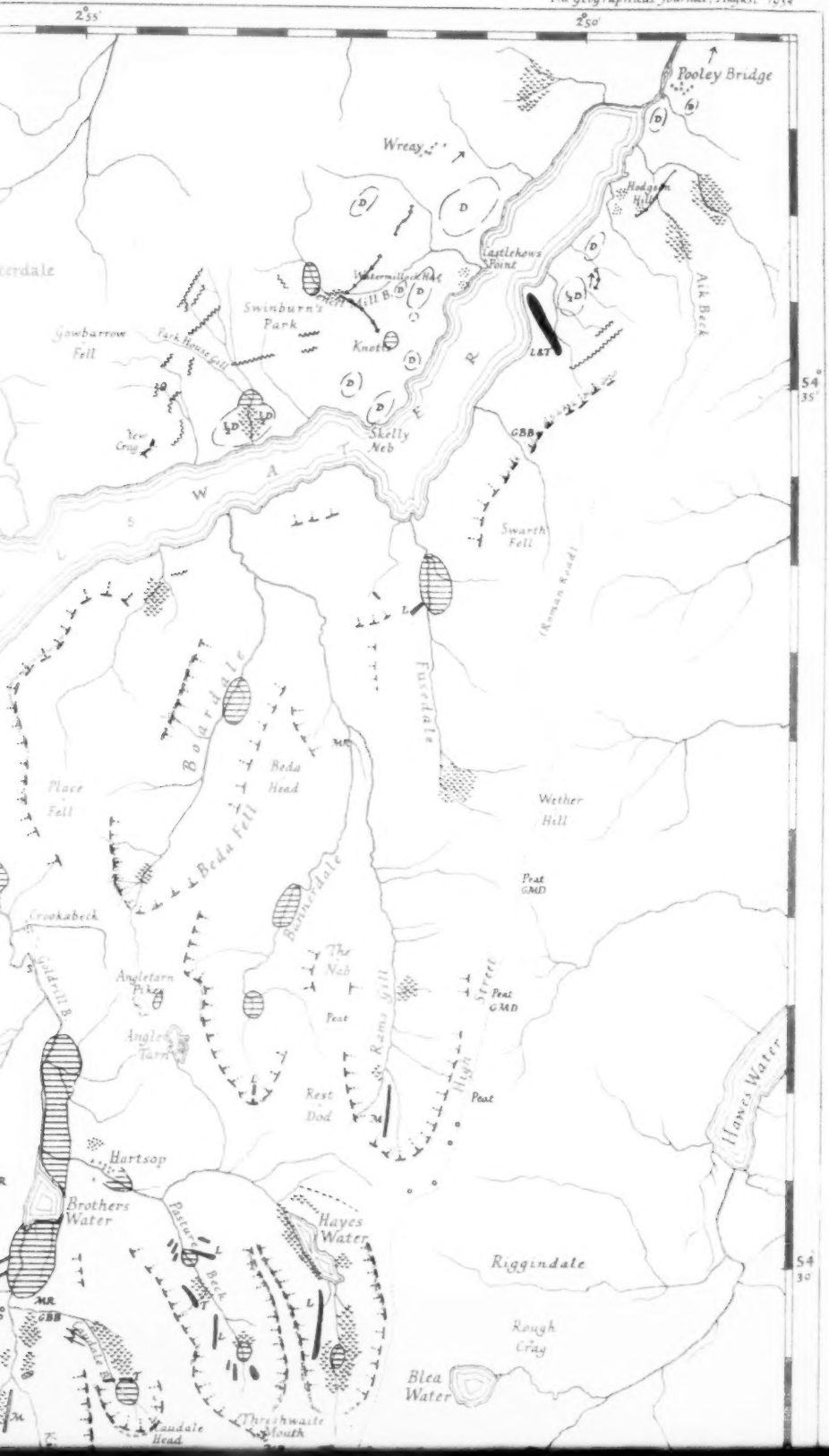
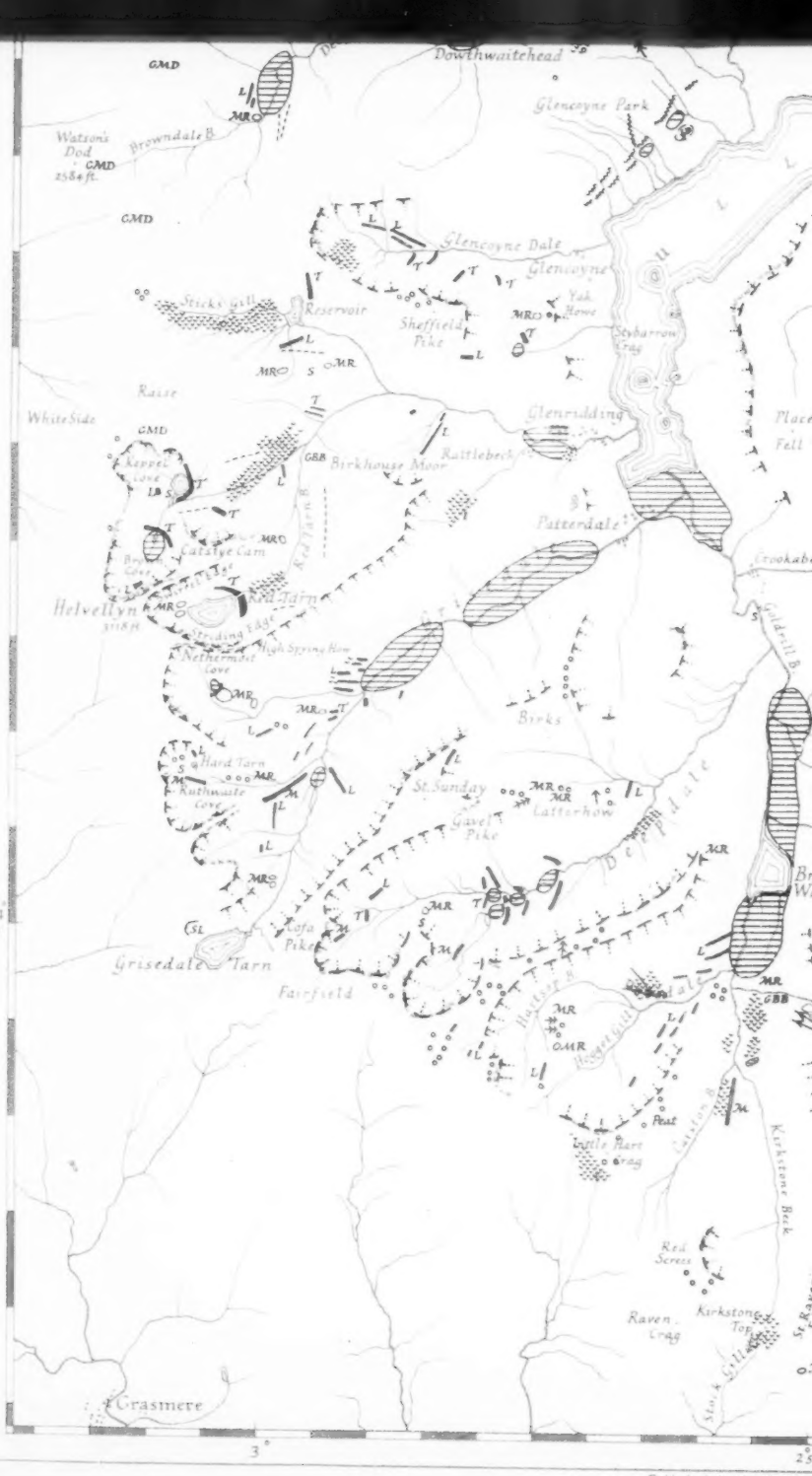
St Sunday Crag
Gavel Pike
Deepdale
Grisedale Tarn
Fairfield
Peat

OF THE ULLSWATER AREA
the paper by Thomas Hay





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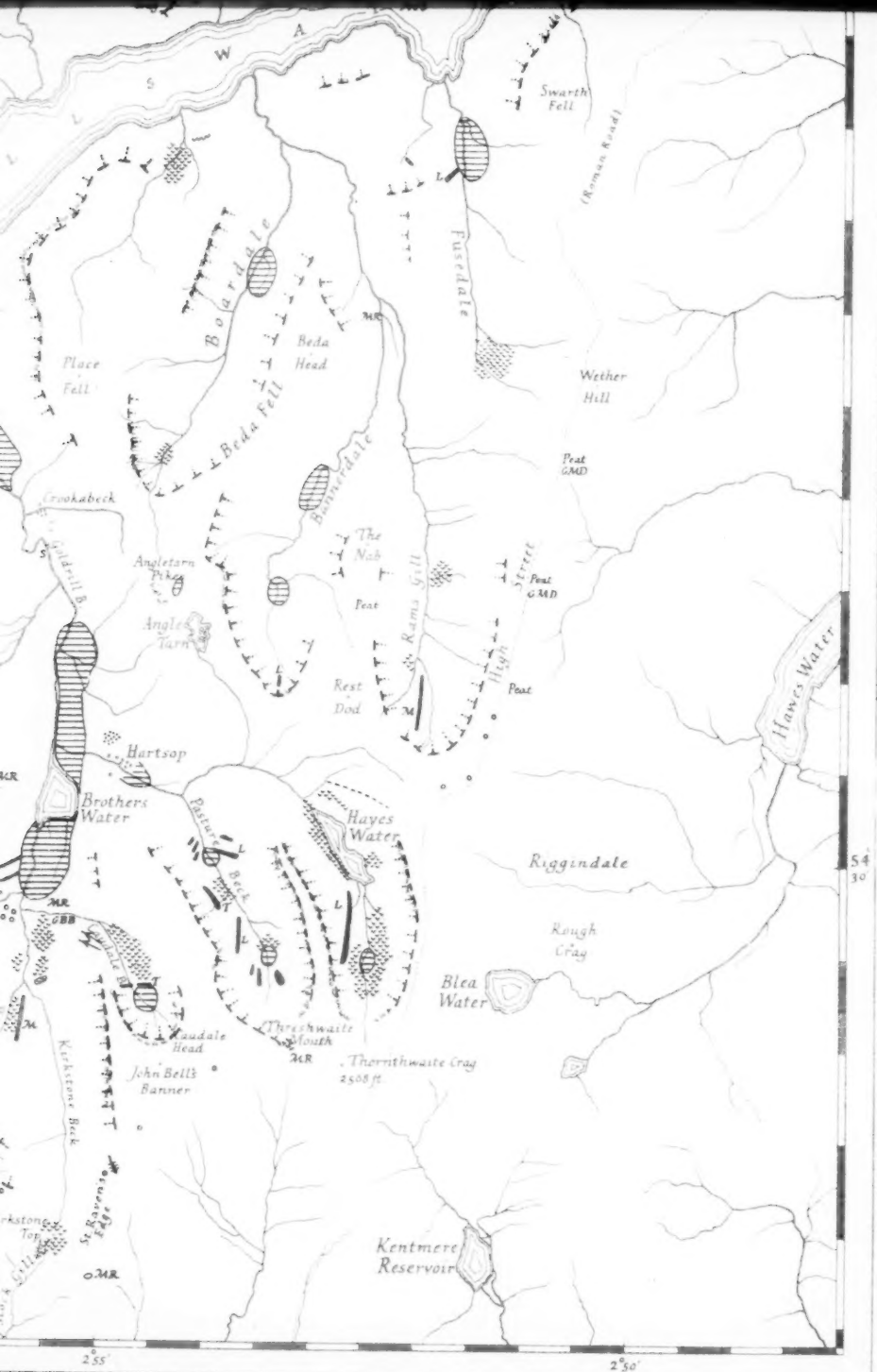

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